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New Fixed Nozzle Automatic Injector.

The accompanying illustrations represent a new fixed nozzle injector that is perfectly automatic in its action. Ordinarily, injectors require the adjustment of both the water and steam supply to start them, and, should the jet break, the same manipulation is necessary to re-start. The instrument in question, however, will start when simply put in communication with the water and steam, and re-starts without adjustment after a temporary interruption of its supply. This automatic action is accomplished without the use of any moving parts whatever, and depends entirely upon the arrangement of overflows and the proportions of the tubes.

The range of capacities is unusually large; at 60 lbs. steam the maximum is four times the minimum capacity taken at the same pressure. This feature is of great value as it enables the injector to be used continuously, and permits adjustment of the delivery to suit the requirements of the boiler. It is also possible to have the supply heated to 150° Fahr. before the action of the injector ceases, when the temperature of the water fed to the boiler is raised to 250° Fahr.

The external view shown in the cut, represents the injector with the overflow placed to discharge on the side opposite that displayed; and this overflow may be shifted to either side, and revolved to any angle, so that the injector may be placed with its body horizontal, vertical or in any position that will permit the overflow to discharge vertically downward. The construction also is such that the tubes may be quickly and readily removed for examination or for cleaning, without disturbing the pipe connections. The combining and delivery tube are in one piece and so arranged that by simply unscrewing the cap at the end of the body, the whole interior of the instrument may be exposed to view. The value of this feature where the feed water is liable to contain sticks or foreign matter is evident, for without trouble or delay it enables the removal of any obstructions which may interfere with the action of the jet.

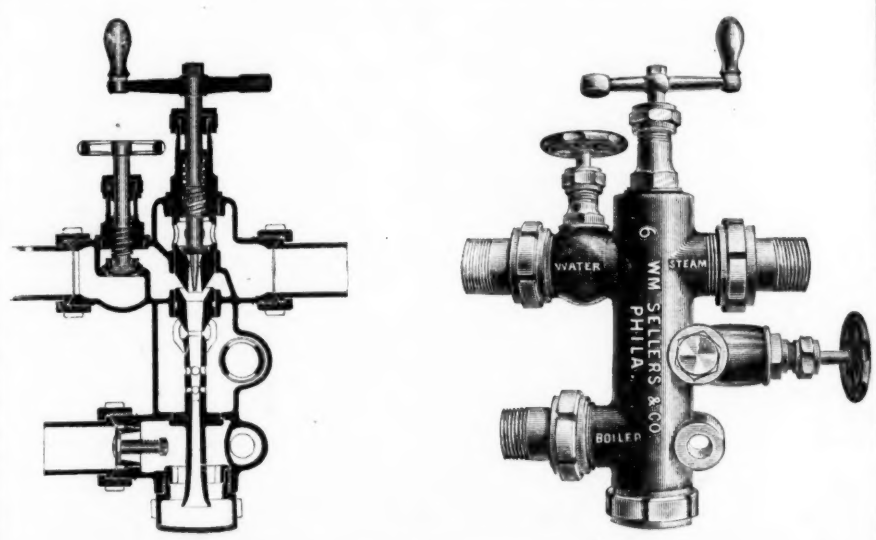
An important peculiarity also of this injector is that it works equally well lifting its feed water as when receiving it under pressure, and no attachments are required to accomplish this in either case. It is self-contained, having in its body the valves for steam and water, and a check valve for delivery pipe, so that only as an additional precaution need extra fittings be purchased; although it is generally considered advisable to set supplemental valves in the boiler connections.

This injector is one of the recent productions of Wm. Sellers & Co., of Philadelphia, Pa., and its advantages have been proved in service, the value of the automatic action especially having been demonstrated by severe tests on traction engines.

A Bill to Protect Machinery and Other Salesmen.

Senator Platt, of Connecticut, has introduced into the United States Senate a bill to relieve commercial travelers from license taxes. The bill makes it a misdemeanor for any officer of a State or municipal corporation to interfere in any way with a commercial traveler selling goods in a State of which he or the merchants he represents are not citizens.

The passage of this measure will make glad the heart of many an industrious machinery salesman. It will also doubtless result in some increase of orders in some machinery establishments, affording a corresponding benefit to the shops producing as well as the shops using the tools so introduced.

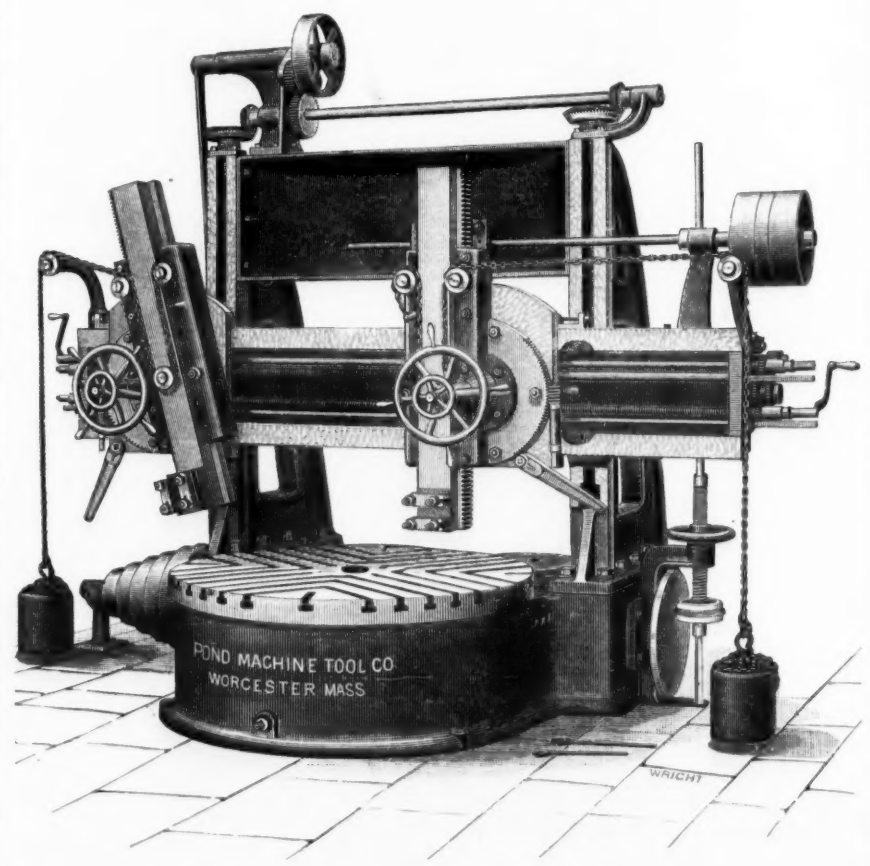


AUTOMATIC INJECTOR.

How is your boiler set? Is it covered with a double layer of bricks? If so, calculate the weight of those 200 or more bricks, and find that you are carrying over 1,600 pounds unnecessary weight on your boiler.

Six-foot Boring, Turning and Slotting Mill.

This machine, which we illustrate herewith, is made by the Pond Machine Tool Company, Worcester, Mass. It is designed for boring and turning pulleys, and for doing a class of work usually done on a lathe. In truing up work a single turn of a screw, convenient to the workman, lifts the table clear of the annular bearing at



BORING, TURNING AND SLOTTING MACHINE.

outer edge. For large work the table is run on this annular bearing; for small work the table may be run free from the outer bearing, the heavy spindle being ample for the purpose. In this case a step at the lower end of the spindle carries the weight. The table is driven by means of cut spur gearing, no bevel gears being used.

The cross-rail has power attachment for raising and lowering. The saddles are secured to the upper and lower edges of this rail by square gibs, and are attached to the feed screws by nuts that can be opened to permit a quick movement by hand, operated by a ratchet through pinions engaging with rack on cross-rail.

The tool slides are of rectangular hollow section, affording large bearing surfaces and the requisite strength; they can be set at any angle by means of worm and ratchet attachment, and are operated by friction feed. They are so balanced that they can be easily worked by quick hand movement when feed is thrown out. The feed, at any angle, up, down or across, of one tool, is automatic, and independent of the other. It is operated by a disk and friction wheel and can be instantly varied from 0 to $\frac{3}{4}$ inch.

The slotting attachment is driven from an independent countershaft, arranged with swing frame to ensure proper tension of belts at any position of cross-rail. These belts, by means of suitable worm gearing, give a forward and backward motion to one of the tool slides. When not in use for slotting, the disengagement to permit both heads to be used for boring and turning, is quickly made.

For turning pulleys on arbors, equalizing driver plate, a saddle or cross-rail fitted with spindle, same as tail-stock of a lathe, and a center fitted to face-plate are furnished. The swing of the machine is 73½ inches, and the boring bars have a traverse of 48 inches. Driving cone has five steps, for a 4-inch belt, giving ten regularly progressing changes of speed. The slotting tool has a traverse of 20 inches. The machine will take 48 inches under the cross-rail.

Thinking and Unthinking Shop Men.

BY S. W. GOODYEAR.

Let us stand back out of the way and watch two men who work side by side on planers. See how quietly one of them goes along in fastening his work in place, and getting it down solid, with no springing out of place. First, he is sure that the table is brushed off clean, and that no bruised projections are in the way. Next, he will remove all sprews, or other projections, from the lower surface of the piece which is to be fastened to the table, as far as they will interfere with an even bearing. Then he lays the piece down and feels of it with thumbs or fingers, pressing down if it is light, or stooping if it is heavy, to note the space between at points where it does not bear, tapping lightly with his hammer — not pounding—to see where it is down solid. He will soon determine how much blocking is needed, and where; and he will have it, too, in the shape of bits of sheet metal and wedges, with bits of cardboard and scraps of paper, even down to the thinness of tissue, of which he carries a stock in his pocket for special cases.

Now, with the piece resting evenly, comes the fastening down; and here our careful, thinking man again shows his peculiar capacity for doing this particular kind of work. Whether the work is to be held in place by screws or wedges, care will be taken to have

them tend to hold the piece down; and if straps and bolts are used, care will be taken to bring the pressure from above, inside of that part of the base, which each strap is to do its part of holding firmly down to the table. With fastenings secured, and a few reassuring taps with the hammer, the cut will be started; and when the planing is done, unless there was some hidden strain in the metal, releasing the piece from its fastenings will show that a surface has been made which will lie fairly on the table for planing the second side without blocking. Watch this man as long as you choose, and you will discover a method in every move which he makes. He does this and that because he expects certain results to follow; and planing, to him, means more than taking off so much metal.

Let's look at the other man. He only half cleans off the table on which he is to fasten his work, and, throwing the piece on without looking for sprews or lumps—that's not his business, the casting cleaner does that—he proceeds to fasten the thing in place, and drive it down, if it don't come, when wedges are driven or screws turned up, and the chances are that with the slight care taken to block up where needed, and to have wedges or screws draw down, rather than to force the piece up from the table, there will be lots of hammering to do. If he uses straps and bolts to hold the piece down, no care will be taken to block under the business end of the strap in such a way as to bring the pressure within the base, but oftentimes the blocking at the back end of the strap will be insufficient, and the pressure coming on an overhanging corner, exerts an influence which would raise the opposite side of the piece only for the counteracting force of other straps. But this man will get it on somehow, and he may do as much planing as our careful, thinking man. And he will probably sneer at the other man for being "so nice." He will do more pounding and growling in a day than the other does in a month, and there is almost invariably some crookedness about his work which has to be laid to a strain in the metal. "Of course, when a chip is taken off and the piece is released, it springs, you know." Why, of course we do; but why is it the exception with the work of our careful man, who won't move a peg till he knows that he is right, and the rule with your man who "pushes things along and does something?"

The Spencer Damper Regulator.

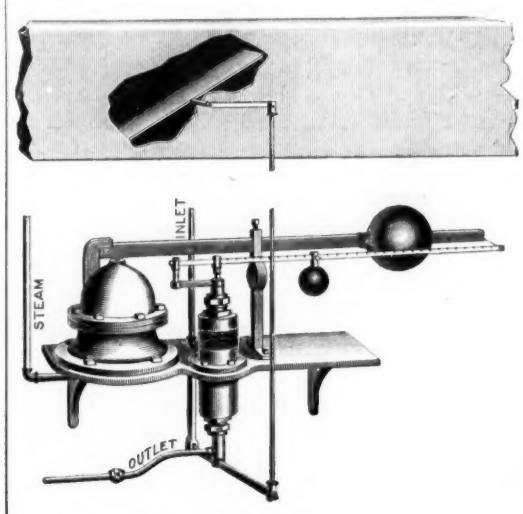
The object aimed at in the design of this regulator, is to provide one of sufficient power and sensitiveness to hold the damper in the exact position required instead of keeping it either entirely open or closed.

The large disk shown in the engraving contains a rolling diaphragm of large area, which is thoroughly protected by the conical cover shown, there being a small opening in the top to allow the pressure cap to work the large weighted lever, which weight can be moved and fastened at any point desired, thus determining the pressure. At the end of the large lever is connected the small lever, which extends back to the long cylinder or motor; the latter contains a double-ended piston packed with a durable cup canvas packing. To the piston is connected the piston-rod, which extends through both ends of the cylinder. To the lower end of this rod is connected the lever, as shown, to operate the damper. To the upper end is attached the short arm, to which the small weighted lever is attached. A small hole extends through the stem or body of piston, to which is nicely fitted a balanced valve, which opens and closes ports to each end of the piston.

The pipe marked "steam," is connected to any convenient part of the boiler, preferably the steam dome, to get the boiler pressure. The pipe marked "inlet," is connected to the feed pipe, between the check valve and boiler. The pipe marked "outlet" is connected to the hollow piston-rod, and can be carried to any convenient place; the quantity of water used amounts to only a few gallons per day.

The bearings of the whole machine are hung on knife edges, and the small weight is to keep the small lever to its bearings, also to admit of fine adjustment; the machine may be located in the engine room, or any other desired place.

The operation is as follows: Supposing the weight is set at 70 lbs. boiler pressure. The lever would be midway of its stroke, and the damper half open. If the pressure should drop a fraction of a pound, the lever would drop slightly, carrying the small valve with it, through the medium of the small lever,



SPENCER DAMPER REGULATOR.

which would open the upper port in the piston to the high pressure water, at the same time opening the lower port to the exhaust. The small valve having made its motion, and opened the ports, the piston is forced down sufficiently to close the ports, where it stops, correspondingly opening the damper, and no amount of power could move it without breaking some of the connections. If the pressure falls a little more, the same operation is repeated, up or down, as the pressure in the boiler may vary, until the whole stroke is completed.

The variation in pressure required to work the damper its whole stroke is said to be about one lb. This regulator is manufactured by Smith & Smart, of Salem, Mass.; Geo. S. Searle, of the same place, is the manufacturers' general agent.

Modern Locomotive Construction.

BY J. G. A. MEYER.

SEVENTEENTH PAPER.

TO FIND THE POINT OF CUT-OFF WHEN LENGTH OF CONNECTING-ROD IS GIVEN.

During one revolution of the crank the piston makes two strokes; one stroke we will call the forward stroke, and the other the return stroke. When the length of the connecting-rod is assumed to be infinite, and the valve constructed according to the foregoing methods, and having the same amount of lap at each end, then the valve will cut-off equal portions of steam in the forward and return strokes.

When a connecting-rod of definite length is introduced, instead of a rod whose length is assumed to be infinite, but leaving everything else unchanged, then the portions of steam cut off in the forward stroke will not be equal to that cut off in the return stroke. To illustrate this, let us take the following example:

Example 25.—The length of the connecting-rod is 4 feet (this short length has been adopted for the sake of clearness); stroke of piston is 24 inches; lap of valve, $1\frac{1}{4}$ inch; no lead, and travel of the valve $5\frac{1}{4}$ inches; find at what part of the forward stroke, and also at what part of the return stroke, steam will be cut off.

In order not to complicate matters, we will assume the length of the *eccentric-rod* to be infinite. This problem will be divided into two parts. 1st. It will be shown at what part of the forward, and also at what part of the return stroke steam will be cut off when the length of the connecting-rod is assumed to be infinite.

2d. It will be shown at what part of the forward, and also at what part of the return stroke steam will be cut off when the connecting-rod is 4 feet long.

Fig. 81. Draw a straight line, $A\ B$; on this lay off the exhaust and steam ports; draw the section of the valve, so that it will overlap each steam port $1\frac{1}{4}$ inch as shown; drawing the valve in this position we represent it to be in its central position. Take the edge c of the valve as a center and with a radius of $2\frac{5}{8}$ inches (equal to half the travel) draw the circle $a\ b\ m$. The circumference of this circle will represent the path of the center of the eccentric and also that of the crank-pin, (see example 18.)

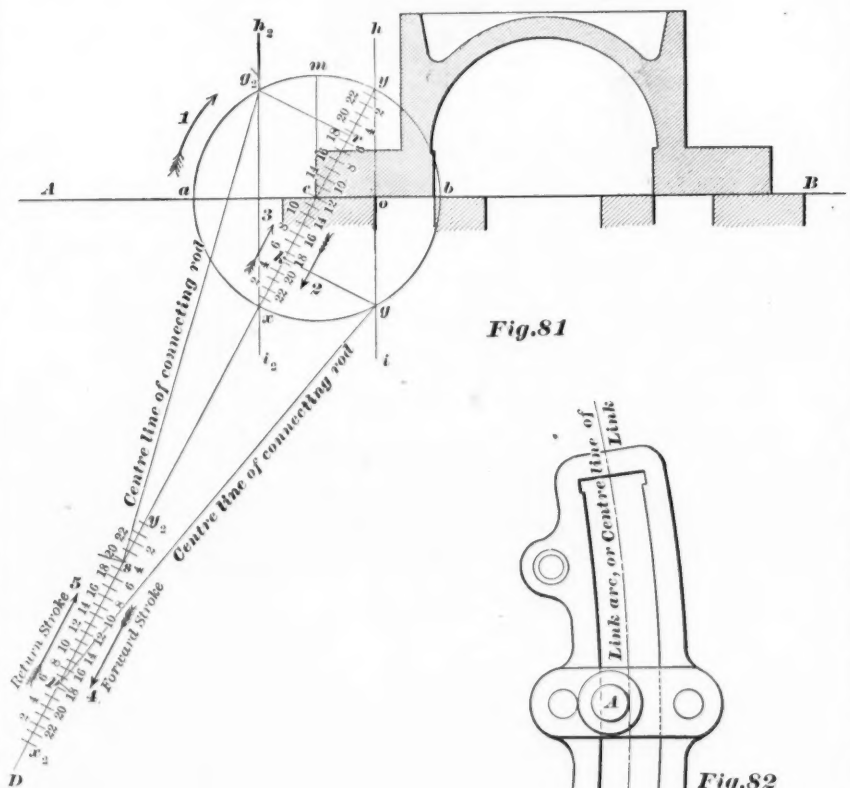


Fig.81

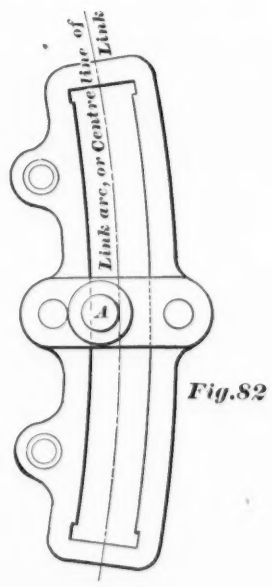


Fig.82

The direction in which the crank-pin is to move is indicated by the arrow marked 1. Since there is to be no lead, draw through the outside edge, o, of the steam port, a straight line $i\ h$, perpendicular to $A\ B$, intersecting the circumference $a\ b\ m$ in the point y and g. The point y will be the center of the eccentric, and also the center of the crank-pin when the piston is at the beginning of its forward stroke, and the point g will represent the center of the eccentric and that of the crank-pin at the moment that steam is cut off in the forward stroke. Through the point y and c, draw the diameter $y\ x$, which will represent the stroke of the piston; divide $y\ x$ into 24 equal parts, each part will then represent one inch of the piston's stroke. The direction in which the piston moves during the forward stroke is indicated by the arrow 2, and consequently, in the return stroke, the piston must move in the direction as indicated by the arrow 3. Since y is the beginning of the forward stroke, we commence at y in marking the inches 2, 4, 6, etc.; and because x is the beginning of the return stroke, we commence at x in marking the inches 2, 4, 6, etc.

Through the point g draw a straight line perpendicular to $y\ x$, intersecting the latter in the point k, which is found to be located $18\frac{5}{8}$ inches from the point y, therefore the piston will travel $18\frac{5}{8}$ inches from the beginning of its forward stroke before steam is cut off. So far, the construction is similar to that shown in Fig. 55, and explained in example 18. We have assumed that the diameter $y\ x$ represents the stroke of the piston, the point y, the beginning of the forward stroke, and the point x, the beginning of the return stroke. But in these constructions, the center of the crank-pin and the center of eccentric are always assumed to be represented by the same point, therefore the point x will also represent the position of the center of eccentric, when the piston is at the beginning of the return stroke. Since the amount of lap is the same at either end of the valve, the center of eccentric must travel from the beginning of the return stroke x through an arc, equal to the arc $y\ g$ in order to reach the position at which the steam will be cut off in this stroke; therefore the arc $x\ g_2$ must be made equal to the arc $y\ g$. The best way to accomplish this, is to draw a line $i_2\ h_2$ through x, and perpendicular to $A\ B$, intersecting the circumference $a\ b\ m$ in the point g_2 then the arc $x\ g_2$ will be equal to the arc $y\ g$, and the point g_2 will be the position of the center of eccentric, at which steam will be cut off in the return stroke.

Through the point g_2 draw a straight line $g_2\ r$ perpendicular to $y\ x$, cutting the latter in the point r. The distance from x to r will represent the portion of the stroke during which steam will be admitted into the cylinder, and since, according to our construction, the point r is situated $18\frac{5}{8}$ inches from x, it follows that the piston will reach the point of cut-off when it has traveled $18\frac{5}{8}$ inches from the beginning of the return stroke. Here, then, we see, that when the length of the connecting-rod is assumed to be infinite steam will be admitted into the cylinder during equal portions of the two strokes, or in other words, the distance from the beginning of the forward stroke to the point of cut-off, will be equal to that in the return stroke. Now, let us consider at what part of the stroke steam will be cut off when the connecting-rod is four feet long.

If the valve is drawn full size in the construction, then the diameter $y\ x$ will be $5\frac{1}{4}$ inches long; but we have assumed that this diameter also represents the length of the stroke of piston, which is two feet, therefore when we lay off the length of the connecting-rod, we must adopt the diameter $y\ x$ as a scale two feet long, consequently, one half of this diameter, (which is equal to the radius of the circle $a\ b\ m$) will represent one foot, and the length of the connecting-rod, which is 4 feet long, will be equal to four times the radius of the circle $a\ b\ m$. Prolong the line $y\ x$ to any length, say, to D, then the path of the crosshead-pin will lie in the line $y\ D$, or, in other words, the center of crosshead-pin will always be found somewhere in the line $y\ D$. From the point y as a center, and with a radius equal to the length of the connecting-rod (equal four times the radius of the circle $a\ b\ m$) describe an arc cutting the line $y\ D$ in the point y_2; this point will represent the position of the center of the crosshead-pin when the piston is at the beginning of its forward stroke. From the

point x as a center and with a radius equal to the length of the connecting-rod describe an arc cutting the line $y\ D$ in the point x_2, and this point will represent the center of the crosshead-pin when the piston is at the end of the forward stroke, or the beginning of the return stroke.

The distance between the points y_2 and x_2 will represent the length of stroke, and will be equal to the diameter $y\ x$. Divide the distance between y_2 and x_2 into twenty-four equal parts and number them as shown. The arrow marked 4 indicates the direction in which the piston moves during the forward stroke, and arrow 5 indicates the direction of the motion of the piston during the return stroke. From the point g in the circumference $a\ b\ m$ as a center, and with a radius equal to the length of the connecting-rod describe an arc cutting the straight line $y\ D$ in the point p; this point p will be the center of the crosshead-pin, when steam is cut off in the forward stroke of the piston, and, as will be seen in the figure, the point p is situated midway between the divisions marked 17 and 18, and therefore indicates, that steam will be cut off when the piston has traveled $17\frac{1}{2}$ inches from the beginning of the forward stroke y_2.

From the point g_2 (in the circumference $a\ b\ m$) as a center, and with a radius equal to the length of the connecting-rod, describe an arc cutting the line $y\ D$ in the point s, this point s will be the position of the center of the crosshead-pin, when steam is cut off in the return stroke, and as will be seen in figure, is situated $19\frac{3}{4}$ inches from the beginning of the return stroke x_2, and therefore indicates that steam will be cut off in the return stroke, when the piston has traveled $19\frac{3}{4}$ inches from x_2. Here, then, we see, that when the connecting-rod is 4 feet long, steam will be cut off in the forward stroke, when the piston has traveled $17\frac{1}{2}$ inches, and in the return stroke steam will be cut off when the piston has traveled $19\frac{3}{4}$ inches, making a difference of $2\frac{1}{4}$ inches between the two points of cut-off. This difference is caused by the angularity of the connecting-rod, or in other words, by the angle formed between the center line of the connecting-rod and the line $y\ D$. This angle can be reduced by making the connecting-rod longer, but not changing the length of the stroke, and consequently the difference in position between the points of cut-off in the forward and return strokes will be decreased. But in all engines in which the valve receives its motion direct from the eccentric, and has an equal amount of lap and lead at each end of the valve, there will always be difference in the position of the points of cut off, even if the connecting-rod is comparatively long.

Should it be desirable to make the valve in these engines to cut off equal portions of steam in the return and forward strokes, then the only way that this can be accomplished, is by giving the valve more lap or lead at one end than at the other. When a link is interposed between the valve and the eccentric similar to that in locomotives and shown in Fig. 29, then the valve can be made to cut off equal portions of steam in the forward and return strokes, without making a difference in the lap or lead of the valve. Indeed, in locomotives, the amount of lap at each end of the valve is always equal, and the lead at each end of the valve is also equal.

When the valve, or the valve gear, is constructed so as to make the valve cut off equal portions of steam in the forward and return strokes, the cut-off is said to be equalized. To equalize the cut-off in a locomotive, the saddle-pin A is moved out of the center of the link, as shown in Fig. 82, that is, the center of the saddle-pin is moved a certain distance toward the center from which the link has been drawn; and besides this, the lifting-shaft arms must be made of the proper length, and lifting shaft placed in the correct position. To determine how much the saddle-pin must be moved out of center, and what length to make the lifting-shaft arms, and where to place the lifting shaft, so that the cut-off will be equalized, has been explained by the writer, in a series of papers under the title of "Laying out Link Motion," the first of which appeared in the AMERICAN MACHINIST May 10th, 1884.

In a locomotive it is of great importance to equalize the cut-off, as this will cause the engine to work smoother and better than with a cut-off not equalized. Again, an equalized cut-off will produce an exhaust at regular and equal intervals, an attainment which is in itself of the greatest importance, because when an engine is running, the sound of the exhaust indicates to the engineer the working conditions of such parts of mechanism as are out of sight; hence the engineer, besides keeping a strict look-out for the parts of mechanism which are in sight, and performing other duties imposed upon him, constantly listens to the exhaust, and as long as this beats at regular and equal intervals, he knows that the valve and valve gear are in good working order, or, so to speak, are in a healthy condition; but as soon as the exhaust commences to beat at irregular or unequal intervals, the engineer accepts this fact as a warning that something is seriously wrong, and that an immediate examination of his engine is absolutely necessary.

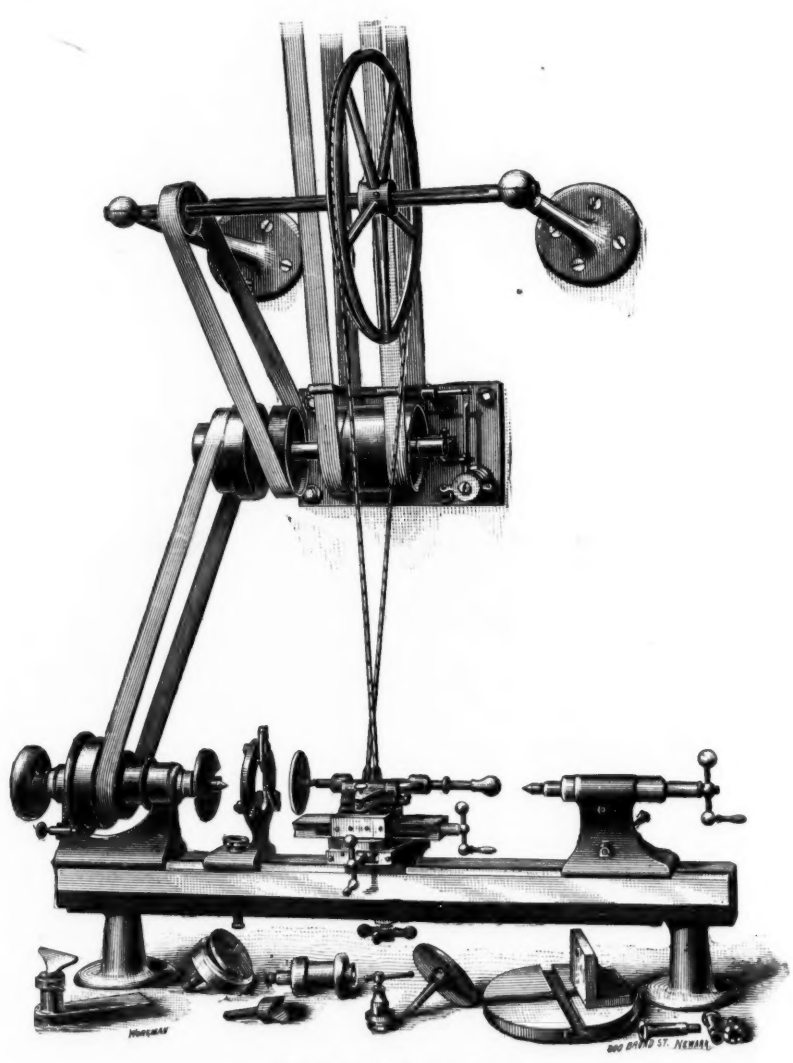
In the foregoing construction we have assumed that the eccentric-rod is of an infinite length. Such an assumption will in no wise interfere with the positions of the points y and x, which indicate the position of the center of eccentric, when the piston is at the beginning of the forward and return strokes, and if these points are located with absolute exactness, and according to foregoing instructions, the positions of these points will be absolutely correct. But these remarks do not apply to the points g and g_2, which indicate the positions of the center of eccentric, at the moment that the steam is cut off in the forward and return strokes.

To find the correct positions of the points g and g_2, we should take into consideration the length of the eccentric rod, which, on account of its angularity during the travel of the valve, will affect somewhat the positions of the points g and g_2, and consequently the points of cut-off will also be affected. Yet, the change in the positions of the points g and g_2 that will occur when the length of the eccentric rod is taken into consideration, will be so slight, that for ordinary engines it will hardly be appreciable, and therefore may be neglected. Still, in equalizing the cut-off in locomotives, the length of the eccentric rod is taken into account, as will be seen in the papers relating to "Laying out Link Motion."

Machinist's Bench Lathe.

The engraving presented with this, represents the bench lathe, made by Sloan, Chace & Co., 289 to 293 Washington street, Newark, N. J. It is a very complete tool of its class, and is made with approved conveniences for rapidly operating on a variety of work.

The spindle is hardened, and runs in hardened steel bearings, the fits being accurately made by grinding. The spindle has a half-inch hole through it; it is adapted to take self-centering spring chucks for holding wire $\frac{1}{100}$ inch or less in diameter. A thread and ground bearing on the outer end of spindle enables large face plates, or any of the scroll chucks in common use, to be firmly attached; by removing drawing-in spindle, stock of a diameter of one-half inch may be worked. At the back end of the spindle space is provided for the screw-cutting attachment gear, or for dividing plate.



MACHINIST'S BENCH LATHE.

The cone pulley has a row of 120 accurately spaced index holes, giving a large number of sub-divisions. The slide-rest may be set at any angle, having an entire circle graduated; the feed screws are graduated to move both slides by thousandths of an inch. The grinding attachment to the slide-rest is fitted to the T-slot of the tool post, and will grind outside or inside, straight or at any angle.

The countershaft is arranged to be driven by two belts from different sized pulleys, giving, with the cone pulley, six changes of speed; it is also provided with a pulley for driving the grinding countershaft. Countershafts are also made provided for being driven by three belts, one of which may be used as a backing belt in screw-cutting.

Many attachments, not shown in the engraving, are furnished with these lathes, such as boring-rest, grinding-rest, screw-cutting attachments (cutting all threads from 10 to 220 pitch), four-spindle revolving tail-stock, three-spindle tumble-rest, double-ended slide-rests in two styles, etc.

These lathes are made 7″ swing, and of different lengths to suit. They are made with special tools, securing uniformity and interchangeability of parts, and in the alignment of head and tail-stock. The size illustrated is known as the "No. 5."

According to the *Organe des Mines* a company is about to begin the manufacture of paper rails near St. Petersburg. It is further stated that the rails will be made in longer lengths than at present, and greater adhesion between these rails and the engine driving-wheels is claimed.

A curious argument is advanced that the burglar, so far from being a curse, is a blessing to society. It is argued that the fact of his existence gives employment to many men as detectives, and that artisans and inventors are constantly employed in devising means of circumventing him.

A large proportion of the flax raised in the United States goes to waste, being cultivated solely for the seed. But very little linen is manufactured in this country, while large quantities are imported. There is undoubtedly room for increasing the manufacture of linen goods here, and probably opportunities for mechanics to improve the machinery and appliances used in the manufacture. The field is apparently an important one, if sufficient energy and capital are put into it.

Periodically complaints are made that the term horse-power is incorrect because it does not express the actual power of an average, or even an exceptional, horse. This really makes no difference. The animal should be entirely eliminated from the mind, and the term taken at its exact meaning, viz., the raising of 33,000 pounds one foot high in one minute of time. A horse would fall far short of doing this for ten hours in a day; a steam-engine will do it for twenty-four hours.

The constant aim of inventors seems to be to devise automatic means for accomplishing certain ends without the aid of human agency. But in every endeavor of this kind there is a hitch. That is, every such device requires to be watched; ninety-nine times it will go right, the one-hundredth time it will go wrong, and do the mischief. This is true of almost everything of the kind. Automatic boiler feeds are all right in theory, but in practice they are wrong the one-hundredth time. Automatic railway signals are in the same list. In the end there must be, where a failure involves serious consequences, faithful and competent human supervision.

A novel application of cold-air machinery has just been made in the construction of a tunnel at Stockholm. The tunnel passes through a hill consisting in great measure of a light wet gravel, on which a number of very large houses are built. It was practically impossible to underpin the foundations of these houses on account of the expense, and the contractor, Captain Lindmark, therefore decided to attempt to freeze the gravel by means of cold air, the lining being put in when the material was solid. This has now been successfully accomplished by cold-air machines, made in London. The results have been in every way most satisfactory, and already several large houses have been safely passed under.

An invention, being, to some extent, put into use in England, is a revolving stuffing-box for steam engines. The stuffing box is made separate from the cylinder. On its inner surface it makes a tight joint against the cylinder head, being held by means of studs, with springs under the nuts, against the tendency of the steam pressure in the cylinder to force the stuffing-box away from the head. The stuffing-box is given a slow, rotative motion by mechanical means. This is said to obviate the scoring of rods, or otherwise wearing them out of shape. It is not necessary to screw the box against the head so tightly but that it will revolve quite easily, and the joint is quite tight. The use of this stuffing-box is said to result in a saving in fuel, and as the box is free to follow any up and down movement of the rod, the saving in friction is important, the packing not requiring screwing up so hard as with the ordinary box.

Standard Pipe and Pipe Threads.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

By GEORGE M. BOND.

The value of a system of pipe-thread sizes which would be interchangeable, not only for the product of one particular pipe manufacturer, but for all, has long been urged, and, no doubt, is fully recognized and appreciated, even if not actually adopted and practically carried out.

It was mainly through the efforts of the late Robert Briggs, C. E., that engineering principles were brought to bear upon this subject, and, in proposing formulæ and tables for the dimensions of pipe and pipe threads, he endeavored at that time carefully to carry out those principles practically, in the manufacture of pipe and pipe fittings.

Since that time changes have been going on in the methods of manufacture, and the quantity manufactured being greatly increased, the demands of the trade now require pipe in such sizes and quantities as may have taxed the older methods and facilities to the utmost; so that, owing to the gradual change in size from what probably all manufacturers originally started, and the consequent variation in the sizes of dies used to cut the threads, the actual condition of the interchangeability of pipe threads is, at the present time, far from being satisfactory to consumers who find it necessary to buy their pipe in the open market.

In a letter received by the author from Mr. Briggs, dated March 29, 1882, reference was made to a paper he was soon to publish before the Institution of Civil Engineers, London, and in which he claimed as his the standard list of pipe dimensions as prepared by him when superintendent of the Pascal Iron Works in 1862 and before.

The taper of the thread was then established as 1 in 32 each side, or $\frac{3}{4}$ inch per foot in diameter, up to and including 8-inch pipe.

The length of that part of the thread which was perfect at top and bottom (the angle of the thread being 60 degrees), and which he termed the "complete thread," he expressed generally by the formula,

$$\text{Comp. } T = (4.8 + 0.8\ D)\ P,$$

D being the outside diameter of the pipe, and P the pitch of the thread, equal to $\frac{1}{N}$, N being the number of threads per inch.

A list of these values is given later on in this connection.

The length of perfect thread, expressed by the formula, is followed by two threads imperfect at the top, the bottom only being complete; and finally, the remaining four threads, which are imperfect at both top and bottom, vanish at the surface of the pipe at this point.

In the illustration Fig. 105 (page 5) and which is taken from a sketch contained in Mr. Briggs's letter, the section of one side of 2½-inch pipe indicates this varying character of the thread, and also the angle and the taper.

On the basis of these dimensions, and using the formula of Mr. Briggs for length of thread, the company with which the writer is connected, during the year 1882, made a set of thread gauges for all sizes of pipe from $\frac{1}{8}$ inch to 4 inches inclusive, using every possible precaution to avoid error, and with the greatest care taken to conform to the figures given for the outside diameter, and the thread in the published list issued by Messrs. Morris, Tasker & Co. (Limited), from which these dimensions were taken, and the angle, pitch and taper of the thread.

In the course of time it became evident that pipe threads cut by the dies in general use, would not enter the external or ring gauges, which were each adjusted so as to be a perfect fit on the standard reference gauge or plug, and which represented the data given in the list mentioned for each size pipe.

As an instance of this variation from a definite standard, one case may be cited in which the range of sizes, compared with these gauges, covered pipe threads from $\frac{3}{4}$ inch to 4 inches inclusive, and dies from 2½ to 4 inches inclusive. In nearly every size there was shown a marked increase in the diameter of thread cut by the dies used by the manufacturers who furnished the pipe referred to.

The samples were sent to us for comparison by a corporation doing a large business in pipe and pipe fittings, the pipe they used being obtained direct from the manufacturers.

The gauges used were the external or ring gauges before referred to, and these were so adjusted to the standard plug that the end of the latter was exactly flush with the face of the ring.

Fig. 106 represents the style of gauge used. In the ring, provision is made for adjustment by having the inner ring split in several places, and a fine pitch thread (30 per inch) cut in the outer edge of the inner ring, which is slightly tapering in the thread. A taper binding screw firmly holds this inner ring in its position by expanding it to a fit in the receiving thread of the outer ring.

The samples to be tested were short pieces of pipe, two of each nominal size, with thread cut on the one end only.

They were marked No. 1 and No. 2, those marked No. 1 being from one prominent manufacturer and No. 2 from another.

The following table will show the results of the comparison:

TABLE OF VALUES FOR COMPLETE THREAD DEDUCED FROM ABOVE FORMULA, WITH LENGTH OF ADDITIONAL TWO THREADS AS ABOVE.

Nominal Size of Pipe.	Actual Inside Diam.	Actual Outside Diam.	Length of Comp. Thread.	Length of Comp. Thread 2+Threads.	Pitch of Thread = $\frac{1}{N}$
$\frac{1}{8}$	0.270	0.405	0.19	0.264	27
$\frac{1}{4}$	0.364	0.540	0.29	0.402	18
$\frac{3}{8}$	0.494	0.675	0.30	0.408	18
$\frac{1}{2}$	0.623	0.840	0.39	0.534	14
$\frac{3}{4}$	0.824	1.050	0.40	0.546	14
1	1.048	1.315	0.51	0.683	11½
1¼	1.380	1.660	0.54	0.707	11½
1½	1.611	1.900	0.55	0.724	11½
2	2.067	2.375	0.58	0.757	11½
2½	2.468	2.875	0.89	1.138	8
3	3.067	3.500	0.95	1.200	8
3½	3.548	4.000	1.00	1.250	8
4	4.026*	4.500	1.05	1.300	8
4½	4.508	5.000	1.10	1.350	8
5	5.045	5.563	1.16	1.406	8
6	6.065	6.625	1.26	1.513	8

* 4.07 in Haswell's *Engineers' and Mechanics' Pocket Book*, 35th edition.

Size of Pipe.	Sample Number.	Relative Size as Compared with Gauge.
$\frac{3}{4}$	1	Entered $\frac{1}{3}$ thickness of gauge.
$\frac{3}{4}$	2	" $\frac{1}{2}$ " " "
1	1	" depth of one thread only.
1	2	" " " " " "
1¼	1	" $\frac{7}{8}$ thickness of gauge.
1¼	2	" $\frac{5}{8}$ " " "
1½	1	" $\frac{3}{4}$ " " "
1½	2	" $\frac{1}{3}$ " " "
2	1	" within one thread of being flush with face of gauge.
2	2	" $\frac{3}{4}$ thickness of gauge.
2½	1	" within one thread of being flush with face of gauge.
2½	2	" $\frac{1}{2}$ thickness of gauge.
3	1	" within 1½ threads of being flush.
3	2	" $\frac{3}{8}$ thickness of gauge.
3½	1	" $\frac{1}{3}$ " " "
3½	2	" less than $\frac{1}{3}$ thickness of gauge.
4	1	" $\frac{3}{8}$ thickness of gauge.
4	2	" $\frac{1}{2}$ " " "

In connection with this test of pipe threads, solid dies for 2½, 3, 3½ and 4-inch pipe were compared with the internal or plug gauges.

The 2½-inch die permitted the gauge to enter and the end to pass $\frac{1}{16}$ inch beyond the face of the die, comparing favorably with 2½-inch pipe, sample No. 1.

The 3-inch die had the same small variation, and shows it to be a little larger than the 3-inch pipe No. 1.

The 3½-inch die was apparently correct, as the gauge entered flush with the face of the die when screwed in tightly, and hence did not compare favorably with 3½-inch pipe, either No. 1 or 2. In the 4-inch die, however, the gauge passed $\frac{3}{16}$ inch beyond the face of the die, showing that it was more nearly the size of 4-inch pipe No. 1.

It will be seen from the above comparison that, with the exception of one or two sizes, there has been more or less increase of outside diameter of pipe from the figures originally adopted by the Pascal Iron Works, for the threads in every instance were full at the top and bottom, and certainly looked as if cut with dies which were in good condition. These dies were probably made to conform to the diameter of pipe as would be ordinarily found, and, if made small enough to cut to the sizes represented by the gauges, would evidently weaken the pipe materially, besides imposing too much work upon them in removing the surplus metal.

Some manufacturers, in order to reduce the extra weight of pipe due to this increased outside diameter, have enlarged the inside diameter also, thus keeping the thickness of the pipe within a certain limit; in fact, even less than the original thickness, as the author has every reason to believe, making it practically impossible to cut the original standard thread on pipe as it is now manufactured.

It will be noticed from the comparison, as shown in the table, that only the 1-inch and the 1¼-inch samples were alike, and, while the 1¼ compared favorably, the 1 inch was so much larger than the standard that the pipe only entered the gauge one thread. The other sizes show more or less difference, and the comparison proves that the two samples of the same nominal size were not alike, and the manufacturers evidently were not using the same standard for their dies.

This must certainly be a serious check to confidence in the interchangeability of pipe and fittings, especially by the parties having to rely on samples showing so much variation. This lack of confidence is keenly felt by those who handle pipe in large quantities, as they do not find it possible always to obtain their pipe from the same manufacturer, and, even if this were possible, the chances are against its being uniform to a degree necessary in engineering operations of this kind, unless some united action is taken by all manufacturers interested, and by their competing on the basis that each shall endeavor to use the *same* standard for reference in all pipe and pipe-thread sizes.

One instance in which a non-interchangeability of pipe threads resulted in serious loss to the parties concerned, and which is authentic, may be mentioned here. A prominent corporation doing business not far from New York undertook to execute a contract for fittings for a large factory, in which extensive alterations in their water-supply system were to be made. The threads in the fittings were carefully cut to correspond with pipe which had been found to be quite uniform in size, and which was considered as fairly representing standard sizes in the thread. The fittings, when delivered, were found to be unsuitable for the threaded pipe already in the factory, and with which they were to be connected. The consequence was, the fittings could not be successfully applied, and were rejected.

In a case of repairs likely to be required in any large works where fittings are to be replaced or new joints made, the work is usually done at night, or possibly Sundays; it is then that this question of uncertainty in regard to practicable interchangeability becomes a serious matter. Often, after working all night getting the old work out of the way, the new pipe or fitting is found to be too large, or perhaps too small, so that, even with the advantages of the taper thread, and the proverbial resources and energy of the fitter, the joint cannot be made, or else some other change is necessary to preserve the original lengths of pipe and connections.

All that can otherwise be done is to replace the old fittings and try again at the next time of "shutting down," or by correcting the misfit at the cost of expensive delay. This is certainly not an ideal case, nor is it of rare occurrence.

In the introduction of their system of automatic sprinklers in cotton mills and other factories, the Providence Steam and Gas Pipe Company experience great inconvenience on account of this lack of uniformity, as it is often necessary to send from their works large quantities of pipe cut to short lengths, and which allows little variation in making up the connections. In this system for fire protection of mills, the greatest care is taken to know that every pipe and fitting is interchangeable. No chances are taken, but it often happens that new pipe must be screwed into old fittings, and then the trouble commences.

Dies will wear, and taps for fittings also wear, but all this variation is easily remedied, or at least can be held within reasonable limits, providing some definite standard is adopted and *followed*. A standard which shall be recognized, covering sizes for the outside and inside diameter within practicable limits, and also for the threads which the manufacturers cut upon the pipe thus drawn, can only become a reality and a success when all the larger companies agree to accept such a standard, and to faithfully inspect the pipe, using gauges which must in turn be carefully adjusted to standards reserved for this purpose only. A working gauge cannot possibly remain a standard always, for in this, as in work requiring a higher degree of nicety, such as arms and sewing-machine manufacture, ultimate standards of reference are absolutely necessary. These can be made and can be kept standard.

Gauges such as are represented in Figs. 107 and 108, and which are used for inspecting round iron intended for United States Standard bolts, with limiting variations above and below the standard size, were adopted by the Master Car Builders' Association, June, 1883, and represent what can be done in gauging outside diameters within a practicable limit above or below the standard size.

Reference gauges, like the set shown, serve to verify the working gauges, or to furnish

standards to which worn gauges may be readily adjusted, and thus kept serviceable in spite of wear.

If round bar iron can be rolled within practicable limits, overcoming the "oversize" evil in this case, it seems evident that within limits that may be determined by the difficulties of pipe production to a standard size, the tendency toward larger outside diameters might be checked.

If the outside diameter can be secured within definite practicable limits, the inside diameter will then be determined by considerations of the proper thickness to withstand the internal stress, depending upon the purpose for which the pipe is to be used, with due regard for the weakening effect of the thread cut at the ends.

In sizes larger than two inches, and including six inches diameter, the customary standard of eight threads per inch seems rather too coarse for the average thickness of pipe as now made for ordinary steam and water pressures; it is certainly so in comparison with the pitch of the thread for the smaller sizes. In a recent conversation with J. H. Flagler, General Manager of the National Tube Works Company, he expressed himself in favor of the change for the larger sizes, if possible, to threads of a somewhat greater number per inch, and recommends, also, the adoption of 11 per inch, instead of 11½, now used for pipe of one inch to two inches diameter inclusive.

This would correspond with the pitches of threads for all sizes from ¼ inch to two inches inclusive, as adopted by Whitworth, and which are used universally in England. It would certainly aid in simplifying the question of interchangeability in our own practice, and, should American pipe find a market where English pipe is now exclusively used, any objection on this score could not be urged.

The great pipe lines conveying oil from the wells in Pennsylvania to the refineries in Pittsburgh, Philadelphia, Baltimore, Bayonne, and other points, are laid with pipe which is of special manufacture; the working pressure averages 1,200 pounds per square inch, and hence the pipe is made of extra thickness and lap-welded; it is six inches diameter for the three lines extending from Olean, N. Y., to Bayonne, N. J.—a distance of 300 miles—and the number of threads per inch cut on the ends of 18 feet lengths is 9, being one thread more per inch, or finer than is used for ordinary steam pipe of only 2½ inches diameter. The ends and unions are made with a taper of ¾ inch per foot, and a special sleeve is used to connect the pipe, as the ordinary steam-pipe joints used on 4-inch pipe prior to 1877 would not resist the strain, and leakage caused considerable loss and inconvenience.*

Some discussion has arisen from the fact that, while the taper of pipe threads is ¾ inch, the taps for fittings are often found to be 1 inch taper per foot. At first thought this might seem impracticable, but, when we consider the relations of the fit under these conditions, the pipe being cut to a standard size, and the thread in the fitting also properly cut, we would find that this would tend to produce a better joint, because the first "gripping" of the thread would be at the end of the pipe where it is weakest, or where it would yield most readily, and in the fitting it would take place at its strongest part, which is inside, and would thus avoid the liability to split at the outside edge.

This gradual compression along the thread is more favorable to the conditions of a close fit for the entire length than if both had the same degree of taper, so that the practical difficulties, which are opposed to an extraordinary degree of nicety in pipe thread sizes, are in this way overcome, and good tight joints with the minimum amount of force required to make them so, are the result. The variation from the taper of the pipe in so short a length (about 1 inch for a 2-inch pipe) is almost inappreciable, but this apparently unimportant difference will aid in securing a steam-tight joint, for reasons that it would seem are practically sound, and, while the mathematical calculations as to the exact strains involved during this gradual "flow of metals" might easily be deduced, it is hardly necessary to enter upon them here.

It might be well to include in the investigation of this subject, the most desirable standard for the diameter and threads of drawn brass pipe and the threads of brass fittings. This class of work, and the value of material involved, evidently warrants such a suggestion, not only on the broad principle of uniformity and interchangeability, but in order to establish and put on record the best possible conditions of size and thread which will cover the range of the various diameters and thicknesses of brass pipe ordinarily manufactured.

Should the right sort of action be taken, in this question of practicable uniformity of pipe and fittings, by the manufacturers who have it in their power to shape the means to accomplish so desirable an end, the manufacturers of fittings or of pipe taps and pipe dies would certainly give to it their hearty support, by working even more closely to accepted gauges than may be possible to draw the pipe; for the pipe makers ordered. In the manufacture of taps suited to the straight fittings, his people would make no more unless a man sent the fittings. They had not been able to establish a standard unless it was given them by the party ordering.

Mr. Baldwin said it would be an advantage in the South American market if our fittings corresponded with the English. The people in South America began with English fittings, and had to keep on buying them because the American would not fit.

Mr. Bond said it was not intended that nine threads to the inch be suggested by any means. It was simply desired to point out that in these pipe lines the thread is finer than it would be under the old system.

William Kent moved the appointment of a committee to consider the whole subject, and report at a future meeting.

President Holloway appointed, after consideration, Frederick Grinnell, of Providence; George Schuhmann, of Reading, Pa.; Wm. J. Baldwin, of New York City; B. H. Warren, of Boston, and George M. Bond, of Hartford.

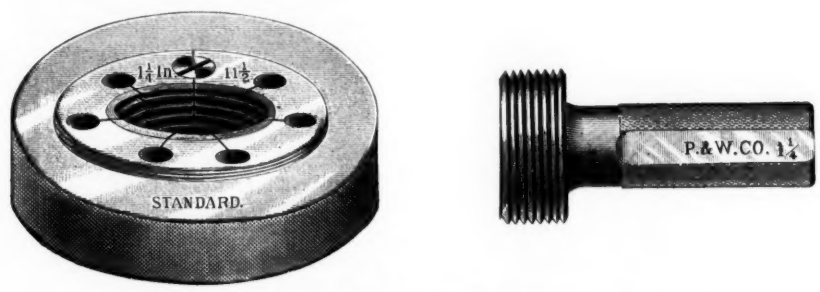


FIG. 106.—STANDARD PIPE THREAD GAUGES, EXTERNAL AND INTERNAL.

FIG. 107.

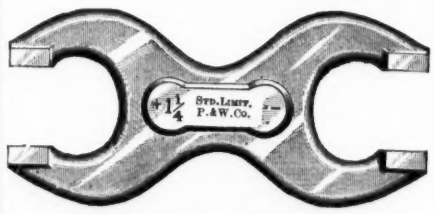


FIG. 108.

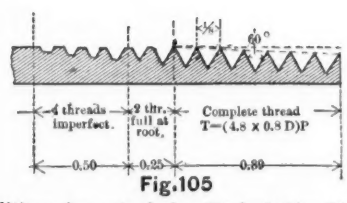


Fig.105

Conditions for actual size 2¼ inch Pipe Thread.
Taper ¾ inch per foot, or 1 in 32.
For whole length of all threads add 6 threads.

although the difficulties and differences as they now exist, are less serious than formerly resulted from the lack of uniformity in bolts and nuts, and which is now happily settled, for the purpose for which the Sellers, or United States Standard thread was intended, yet the value of a uniformity in all pipe sizes is of sufficient importance to be urged upon the attention of those who would be most benefited by its introduction, which includes manufacturers and consumers alike.

DISCUSSION.

Geo. Schuhmann said that at the Reading Iron Works they used standard gauges, and had kept them of uniform sizes for twenty years. The people who used the most pipe were the oil people in Pennsylvania, and they did not want the standard recommended because it was too coarse. Long lines of pipe often depend upon a single joint, and these great pipe lines have a coupling about an inch longer than the common one.

William J. Baldwin said the steam-fitter evidently wants a finer thread on inch and inch-and-a-quarter pipe than 11½. Inch-pipe ought to be cut 14 to the inch the same as three-quarter inch.

George R. Stetson said the toolmakers had no part in this fight. They would make what the steam. It appears, then, as suggested in the original article, that the economy of the engine, under the circumstances of the test, depends mainly on the cut-off, and that the cut-off, for a given power, is longer at a slow speed.

We are always thankful for criticism that will reduce our errors and improve the quality of our work. We wish to be credited with good workmanship, and we intend, by testing our apparatus and instruments ourselves, to know what we are doing.

C. H. PEABODY,

Asst. Prof. of Steam Engineering Massachusetts Institute of Technology.

[In the brief notice we gave these very interesting and valuable tests, we had at hand only the data furnished in the paper presented to the society. In that there is no direct evidence that there is not leakage into the cylinder after cut-off. It is, we believe, generally conceded that it is very difficult, or impossible, to determine exactly what the leakage into the cylinder of a steam-engine in actual operation is, by noting the conditions with the engine at rest; it may be quite different in the two instances. As to the economy at high and low speeds, we find, to be exact, that, according to the tables forming part of the paper referred to, in one instance, the "indicated horse-power" was 1.781, the revolutions per minute 68.55, and the "water per horse-power per hour, by tank," 149.29 lbs. In another instance, the indicated horse-power was 1.56, the revolutions per minute 23, and the water, per horse-power per hour, 87.521 lbs. We suppose that this means (and there is no contrary intimation) water per indicated horse-power. In one case the piston is moved against a resistance due to the pressure of the atmosphere at 68.55, and in the other at only 23 revolutions per minute. This we take to be the chief reason for better economy of low speed, when the load is so very light. We see no reason why it should be referred to the cut-off; the result would not be different, except, perhaps, in degree, if there was no cut-off at all. Less useless work against the atmospheric pressure is done at low than at high speeds.]

LETTERS FROM PRACTICAL MEN.

Condition of the Steam Engine Tested at the Massachusetts Institute of Technology.

Editor American Machinist:

In the AMERICAN MACHINIST of Dec. 5th, in the review of the report to the American Society of Mechanical Engineers of steam-engine tests, made in the laboratory of mechanical engineering at the Massachusetts Institute of Technology, exception is taken to the method of finding the re-evaporation in the cylinder from cut-off to release, and it is inferred that steam may have leaked past the steam valves to such an extent as to vitiate the results of the test.

It is quite possible to know whether there is much leakage through the valves, or past the piston of an engine. The first may, be tested by closing the steam valve and opening an indicator cock, and the second by running the engine with the cylinder head off. As to the engine at the institute, it is known by trial that the leakage is insignificant.

Elsewhere in the article, the greater economy at low speed than at high speed, for, very small powers, is assumed to be due to the different ratios of effective to gross work; but in all cases, the work noted is the indicated work of

Cutting Racks.

Editor American Machinist:

W. Z. B., West Mulford, Mass., asks in your issue of December 12th, some quick way to space off the teeth of racks. Perhaps the writer's experience may be of interest. I have done a great deal of rack cutting on shaper and planer, in the absence of special tools. I infer from the above question that it is desired to space the racks, and plane or shape them out, and have a fair job when done. I will explain how any rack may be cut on a shaper, with a screw of the same pitch as that of W. Z. B., viz., five threads to one inch. We will disregard all decimals east of the third place.

Diametral Pitch.	Corresponding Circular Pitch.
8	.393″
10	.314″
12	.262″
16	.196″

Find a cut gear around the shop (a change gear not much worn will do) of, say, 100 feet; fit it to the screw on shaper, if possible, to be used as a "dividing head" to divide the rack. A 16 pitch requires a horizontal movement of .196″, the screw being 5 threads to the inch, which, multiplied by 100 (the number of teeth in gear), equals 500, therefore, every tooth on the gear represents .002″. Hence to divide a 16 pitch = .196″ ÷ .002 = 98, that is the gear of 100 teeth must pass through a space of 98 teeth from a given point.

All the other pitches are divided the same. The 10 pitch = .314″ ÷ .002 = 157, which would be one revolution, and $\frac{57}{100}$ or 57 teeth. All false motion should be taken up when beginning to divide; even at the best the method will have its error, much, however, depending on the accuracy of the workman.

Lima, Ohio. RALPH E. STATE.

* See London *Engineering*, July 31, 1885; article, "The Transportation of Petroleum."

Mechanical Pirates.

Editor American Machinist:

Do you know the class which I designate by the above title? For the benefit of your readers, I will explain that by "Mechanical Pirate" I mean any man who steals a mechanical idea—one who appropriates another's idea, without giving its author due credit for the same, and then claims it as his own.

For example, a certain machine is built by an established concern and somebody else wants to build machines to do the same work, and supply them to the market, but, not having brains enough to design one, he copies that of the established concern from one end to the other. There is no patent on the machine, nor any other public record, so the copyist, knowing that the law cannot interfere, builds the machine, advertises and talks of it on all occasions, as his own original product. The man who did the hard thinking, and had the genius to produce the machine, never gets from him as much as the mention of his name in any connection whatever.

Again; the AMERICAN MACHINIST publishes a valuable idea in connection with steam-engines. An alleged "editor" sees the article, and copies it for his paper; but instead of giving the AMERICAN MACHINIST due credit for the same, he publishes it in his editorial columns, without the slightest reference to the true author, thus leaving the reader to infer that he is to have all the honor the idea merits.

Here is a *bona fide* example: In the Nov. 14th, 1885, issue of a certain Eastern paper will be found an illustrated article, describing a lathe attachment for "grinding taper work." By reference to "A Treatise on the Construction and Use of Grinding Machines," published by a well-known machinery establishment, it will be seen that the cuts of this article, as well as part of the description, are almost exact copies from the said treatise. But if you consult the paper referred to, for the origin of the device, you will be "very respectfully" referred to its editorial "sanctum sanctorum." The "editor" was modest enough, however, not to take the whole of the machine referred to and set it upon his lathe as an attachment of his own production; but he wisely discarded the *base*, and transferred the main part of the machine to his lathe, without "alteration or amendment." Without alteration? Of course. The very act of piracy is an acknowledgment, on the part of the pirate, that he has no other source from which to obtain ideas.

This business of piracy is practiced too extensively, altogether, and it is to be regretted that there is no means of punishing the offender. The only partial protection we have against the mechanical pirate is in the patent laws, and these do not reach the bulk of the offenders. The patent laws of some countries even encourage this sneaking practice. What mechanic is there who has not, at some time, given a valuable idea to his employer or others, without ever having received credit for the same, either in word or deed?

When the millennium comes, I suppose we will need no laws to enforce honesty (*enforced honesty* sounds rather paradoxical, doesn't it?). Then every man will publish his ideas, if they are considered good, and every man who will be benefited thereby, will send a contribution to the inventor, or author, in recognition of his services. By such a method of procedure, the inventor will be a public benefactor; the public will duly reward him, and the invention will be free to everybody, and everybody will give credit to whom credit is due. But how ridiculous it would sound for any one to preach such doctrines in these days of piracy!

Pawtucket, R. I. C. A. SMITH.

Sharpening Miners' Drills.

Editor American Machinist:

In reply to your correspondent who inquires about sharpening drills, the first requisite is good steel. The best sharpeners always hammer against the end of the drill at the same time they are forming it, thus compressing the steel. The steel should always be worked at as low temperature as possible, and hammered till the color leaves it. The bits should be evenly heated to a cherry red *only on the point*, plunged into water point foremost, and left there till cool. Some smiths lay stress on letting them finish cooling in the air, but I never saw any advantage in this, but rather the contrary.

If the above does not give good results, then the rock must be harder than hornblende. If the drill will not stand, the angle must be made less. I never saw rock so hard that a "bull-bit" was required.

Lemars, Iowa. JOHN L. VARNUM.

Laying Out Step-Pulleys by Proportion.

Editor American Machinist:

James F. Hobart gives some interesting items about laying out step-pulleys in fixing over a lathe in the AMERICAN MACHINIST of December 19.

I have been in that business for the past ten years, and work to the rule that all circles are to each other as are the squares of their diameters.

In Mr. Hobart's example, I would figure the speed as follows: 3,000, 1,500, 1,000 and 250 revolutions per minute.

I have just been fixing up a lathe, and went by the above rule. The result appears all right, and I have no trouble with the belt.

Bath, Me. SUBSCRIBER.

Slotted Mouthpieces and Liner Plates.

(From *The Locomotive*, Published by the Hartford Steam Boiler Inspection and Insurance Co.)

One of the greatest sources of trouble and annoyance in connection with boiler settings, consists in the warping and burning out of the cast-iron mouthpiece of the furnace door. As they are usually made and put in, they expand under influence of the heat, and the expansion results in cracking and distortion which render it almost impossible to keep the front of the furnace lined with fire-brick. This results in overheating and cracking of the cast-iron front, and if the setting is of the flush-front type, the portion of the boiler shell forward of the front head is sure to be burnt also. Our illustration shows a very simple and inexpensive method of overcoming the difficulty.

Fig. 1 is an elevation and plan of a solid mouthpiece as they are usually constructed. On the inner edge of the casting, that is, the edge exposed to the furnace heat, a series of slots are cut as shown in the figure at S_1, S_2, S_3 ---- S_8. These slots should be about 6 inches apart, and should extend a little over half way through the casting. For a mouthpiece 9 inches deep, they may be 5 inches deep; their width should be about $\frac{3}{8}$ of an inch at the bottom, and about $1\frac{1}{4}$ inch on the outer edge.

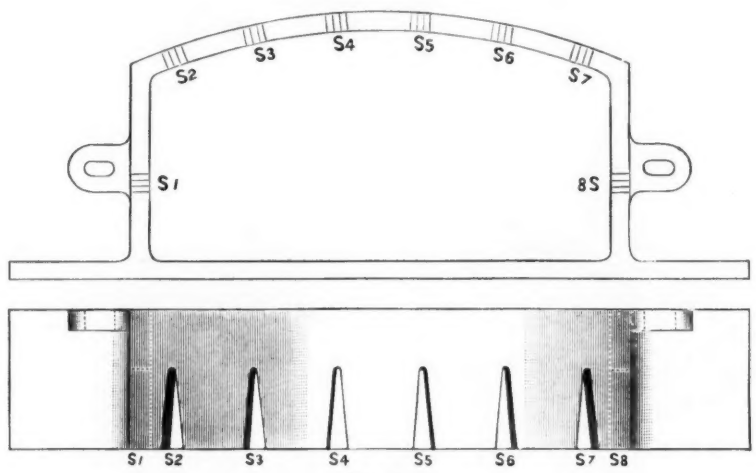


FIG. 1.

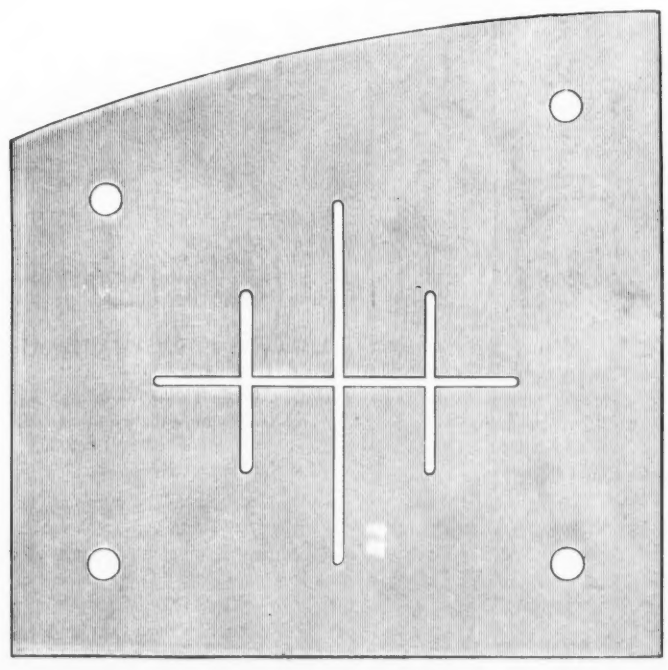


FIG. 2.

Where castings are already on hand, the slots can be easily made by drilling and chipping; when new ones are ordered, it will be to the interest of the purchaser to have the pattern slotted, as thereby they may be provided without extra cost, as the form of the slots does not interfere with the draft of the pattern.

It will surprise any one who has never tried this plan, to find how nicely the casting will keep its shape when slotted as above shown. The reason is very simple. Under the influence of heat the iron is bound to expand; if the slots are present it has a chance to do so without lateral bulging. Without the slots it must go somewhere, and the result is bulging and warping, with the attendant displacement of the brick-work.

Although iron expands under the influence of heat, it does *not* return to its original dimensions when it cools again. This will be rendered evident by the gradual closing up of the slots shown above, under the conditions of every-day use. We have seen them, in extreme cases, close up during a year's run, so that a close examination was required to find a trace of them. With them spaced about 6 inches apart, however, the expansion in a year's run is not generally enough to close them up. They will remain open, and the mouthpiece will retain its shape until the projecting portions are so wasted away from the action of the heat, that they are not long enough to support the fire-brick lining. Longer service than this cannot be expected under any circumstances.

The same principles apply to the liner plates for fire doors. These are exposed to very intense heat, and generally warp and bulge badly. Fig. 2 shows the form of slotting which we would recommend for these plates. They allow of the free expansion of the plate toward its center, and this will enable it to keep its shape. These slots may be easily made by drilling and planing or chipping, or if they are made of cast-iron they may be cast in when the plate is made, as in the case of the mouthpieces.

This same principle might be applied with profit in many other cases where plates, exposed to intense heat, give trouble from warping and cracking.

Reproducing American Engravings.

In our issue of November 21, 1885, we published an article by O. J. Beale, entitled "Cutting Spiral and Spur Gears on a Milling Machine with a Side Tool," illustrating the same with "wax" cuts. The latest issue of the *English Mechanic* copies the article, with due credit, both to the author and to ourselves, but reproduces the illustrations by "process" cuts that bear out our remarks last week on methods of making engravings. Our British friends should learn the Yankee twist in the matter of engravings, or draw on us for cuts as well.

Experiments on the Flow of Superheated Steam Through an Orifice.

The following appendix to the paper on "A New Form of Calorimeter," read before the American Society of Mechanical Engineers, by George H. Barrus, details some interesting experiments on that subject:

It is proper in connection with the paper on a 'New Form of Steam Calorimeter,' to present the following memoranda relating to some experiments made by the writer in October, 1878, on the flow of superheated steam through an orifice. The experiments were made with different degrees of superheating, and in two series. In one, the pressure over the orifice was 28 pounds per square inch above zero, and in the other the pressure was 58 pounds above zero. In both cases the steam was discharged into a surface condenser open to the atmosphere, that is, against a pressure of 14.7 pounds above zero. The orifice consisted of a cylindrical opening in a cast-iron plug, 0.09 inch in diameter, three-quarters of an inch long. The temperature of the steam was taken at a point about five inches above it. The results were as follows:

SERIES OF TESTS WITH 28 LBS. PRESSURE.

Kind of Steam.	Number of Degrees of Superheating.	Weight of Steam Discharged per Hour.
	Deg. Fahr.	Lbs.
Saturated.	0	10.16
Superheated.	10	10.09
"	109	9.16
"	210	8.48
"	309	8.14

SERIES OF TESTS WITH 58 LBS. PRESSURE.

Kind of Steam.	Number of Degrees of Superheating.	Weight of Steam Discharged per Hour.
	Deg. Fahr.	Lbs.
Saturated.	0	20.22
Superheated.	10	19.73
"	109	18.42
"	209	17.18
"	306	16.27

In round numbers an average increase of temperature of 16 degrees in these experiments reduced the rate of discharge one per cent. The results for saturated steam agree substantially with the theoretical discharge calculated from Zeuner's formula.

Confidence.

BY JAMES F. HOBART.

Confidence in one's self goes far toward success. The machinist who is able to go about an ugly job feeling sure that he can devise ways and means for successfully completing the work, is the man who is valuable to his employer. A man who knows how to think, is apt to be such a man, while the man who must depend upon some job he has done before, or who must obtain an idea from his neighbor before he can complete the work, is not the man to make a successful mechanic.

The machinist who don't know what to do, or how to do it after he has got a hint, is a sorry chap on a strange job. He is in misery, and so are all around him. He gets nervous, jumps here and there; picks up a tool and lays it down again without using it; he asks everybody's advice, and don't know what to do with the advice after he gets it.

If a man finds himself in this condition he ought to study to overcome it. Let him learn to think out the effect of a blow before he strikes, and he will soon be able to tell just what kind of a blow is needed in order to produce a desired result.

Here is the whole secret of being a good mechanic: to be able to see in advance just how a finished job should look; to see what cuts are needed to shape the matter as desired, and to know just how to make the required cuts.

Watch the "good machinist" and you will see that he knows in advance exactly the effect of every action he takes. He is like a good artist. He sees the picture as completed, and knows what marks to make and *just how to make them.*

An otherwise good man may have no confidence in himself. He may be too easily led by surrounding circumstances. He may underestimate himself, when his method is best if he only had the nerve to stick to it.

The other extreme is often met with. The "self-sufficient" workman is the man.

What he doesn't know about a job, never ought to be known. This man is another who doesn't know how to think. He sees or hears of a certain way of doing, and advocates that method without thinking why and wherefore, or if the method he advocates will have the desired effect.

The thinking machinist is neither of the above men. He is between them, and never reaches either extreme. He thinks when he is not aware of it, and methods and jigs suggest themselves to him naturally.

No matter how ugly the job, a way to do it always comes along by the time it is wanted. Such a machinist is an example well worth following. He goes quietly about his work; makes no fuss or confusion; and is never at a loss for ways and means. Let us, therefore, learn to think. Instead of running our brains on telling stories, and telling which is the best brand of tobacco, just try the effect of thinking out how work is done, and how it should be done.

When a good way of doing a job is thought of, then stick to that way, and have confidence that you are right. The man who thinks is apt to have confidence in his ideas, and can go ahead to the successful completion of any job that comes to him.

The *Railroad Gazette* has account of a freight train on the Mississippi Valley Railroad consisting of 150 loaded cars and two cabooses, all hauled into New Orleans by one locomotive. The reported length of the train was 90 feet over one mile, but the *Gazette* intimates that a few feet—perhaps the odd 90—might possibly be dropped, and leave the length sufficient for all purposes.

Clement E. Stretton, a well-known English civil engineer, in a communication to *Invention*, says that the practice of long hours on railroads is on the increase in England. He believes the practice to be dangerous, and that some steps should be taken to protect the public from accidents growing out of it.

Richardson's Sliding-nut Spring Caliper.

In this caliper the inner end of the nut is beveled on the outside to fit a corresponding inside bevel on the washer. The nut is cut in two parts, horizontally, from the inner end up to the small knurled end at the outer end. This makes a spring of the nut, the normal condition of the nut being to remain out of contact with the thread of the screw. When the caliper is held as shown in the engraving, the nut can be slid along to any desired position on the screw, then by releasing the hold on the caliper the bow-spring forces the washer on the coned end of the nut, binding the latter on the threads, when the adjustment can be completed as with the ordinary solid nut. Since but little motion of the nut, when locked to the screw, is required, a screw of fine pitch is used, which facilitates close adjustment. The manufacturer of this caliper is C. F. Richardson, Athol, Mass.

Steel rails for the Japanese railways are to be manufactured at the Japanese arsenal. It is said rails have already been made at the Osaka arsenal that are equal in quality to those imported. If railroads are extensively built in Japan and China it is to be expected that eventually the work of equipment will come to be done in those countries, but getting up to do this work will be of slow growth, and during the process a large amount of the work required will be done in other countries. Moreover railroads will carry with them other needs, and open the parts of the countries through which they pass to trade.

A Torpedo Catcher.

Another link in the "chain of destruction" has been formed by the invention of boats called "torpedo catchers."

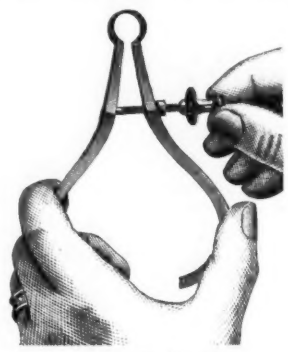
According to *Engineering* (London, Eng.) the construction of torpedo catchers was as much a necessity in naval warfare after the development of the torpedo system of small, quick-steaming torpedo craft, as armored protection for battle ships became in consequence of the growth of the gun. The catchers, or police of the sea, do not differ, except in bulk and speed, from the active and dangerous little enemies which they are intended to capture or destroy, and in this respect the Admiralty would appear to have applied the old detective principle of setting a thief to catch a thief. The first of the new craft yet afloat is 150 ft. long, 17 ft. 6 in. broad, and 9 ft. 6 in. deep; compound engines of the three-cylinder type, the high-pressure cylinder being 20 in. and the two low-pressure cylinders 24 in. in diameter, 18 in. stroke, the whole being supported on light steel columns. The speed is about 20 knots; boiler pressure 125 lbs.

According to *Bradstreet's* the Bureau of Education is considering the position which should be given to art and industrial education in schools and institutions of public training, and will soon publish a report upon the subject. It is understood that the report will recommend the universal teaching in all public schools of the elements of industrial drawing as an essential part of any general system of education.

Pipe Couplings.

Considerable trouble is encountered when putting up a system of piping to withstand high pressure, in obtaining joints which will not leak.

In piping for refrigerating machines where ammonia and its gas is to be used, some engineers tin the surfaces which come in contact, and solder them after being screwed together.



SLIDING-NUT CALIPER.

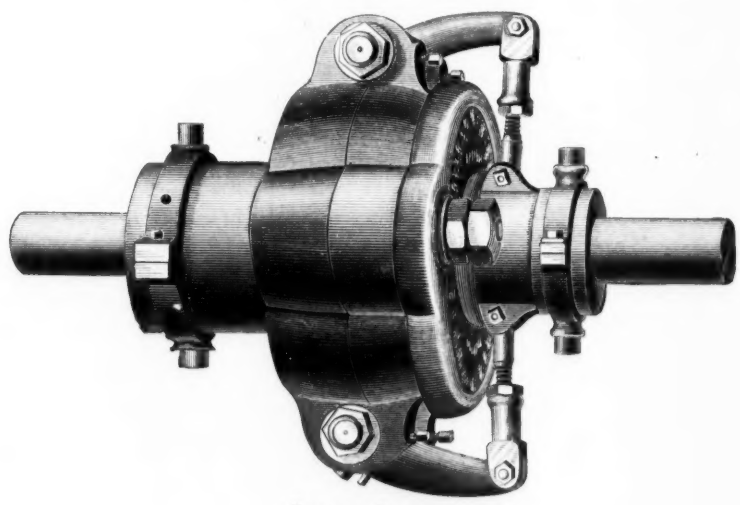
By a recent patent, the pipes and couplings are tinned in the thread, and screwed together while the parts are heated sufficiently to melt the tin. After being cooled, the joint is practically a solid one.

Hunter's Friction-clutch Pulley and Cut-off Coupling.

The recent improvement in this clutch consists in providing two sets of tightening screws and levers in place of one. This makes the design more symmetical, the clutch more powerful, and balances the whole.

A description of this clutch, as formerly made, appeared in the AMERICAN MACHINIST of April 16, 1881, the principle involved being the same in this one, the only especial difference being the doubling of the screws and levers. It is made for either light or heavy work, its strong holding power and the ease with which it is operated making it especially applicable for connecting and disconnecting lines of shafting, water wheels, steam-engines or other heavy machinery.

FRICTION PULLEY.



CUT-OFF COUPLING.

Distilling Coal and Shale.

In its issue of December 4th *Iron*, in discribing a twin retort for distilling coal and shale, says:

"Coalfields yield enormous quantities of mineral similar to coal, but including so large a proportion of earthy matter as to render it unserviceable as fuel, though containing volatile carbonaceous matter generally insufficient in quantity to pay for distillation by any process hitherto used. Throughout the colliery districts there are enormous waste heaps which, like the slag tips of our blast-furnace works, are generally an imcumbrance to the proprietors. With the view of utilizing this waste, a twin retort has been devised by which large quantities of oils (benzoles, naphthas, etc.), tar, ammonia, and gas are obtained from the waste of cannel, shale and coal, whilst the products so obtained are stated to be of much greater intrinsic value than those manufactured by the ordinary methods from best cannel, shale and coal at a high price. Although the retort is applied with excellent results to absolute waste, it is stated to be equally effective with ordinary cannel, coal and shale; and in the manufacture of gas for lighting and heating purposes to be superior to other machinery of the kind in use."

Seamless Boiler Sections.

It is well known that the weakest portion of a boiler shell is in the riveted seams. Various schemes have been introduced from time to time to remedy this defect.

Rolling plates long enough to reach entirely around the boiler dispensed with all but one row of longitudinal rivets. The practice of welding the ends of a circular plate was next tried.

Now we learn that John Windle, Manchester, England, has designed a "vertical ring plate mill," which is being put to practical test by Daniel Adamson & Co., Hyde Junction, near Manchester. This mill is expected to roll circular weldless boiler plates, four feet wide and up to sixteen feet internal diameter, so that a boiler can be built up without either longitudinal welds or rivets.

English *vs.* American Locomotives.

Invention (London, England) characterizes the act of the Treasurer of the Colony of New Zealand, in ordering locomotives from the United States, and in saying that "American locomotives are better than English," as unpatriotic. The intervention of a few miles of salt water makes all the difference in the world in the matter of opinion. It is conceded here that this concession on the part of the Secretary is very creditable to him, because it was undoubtedly made in the performance of an unpleasant duty. The following, from the report of the Minister of Public Works of New Zealand is also displeasing to our contemporary. This part of the report refers to a failure of English contractors to furnish locomotives according to specifications:

In the meantime, being disappointed in not receiving these engines at the time they were expected, I was obliged to order others, and succeeded in making a contract with the celebrated Baldwin Company, of Philadelphia, to supply twelve engines on the same specification as that sent to England in 1883. The order left New Zealand on December 6th, 1884, and we have had advices of the shipment of the whole number at New York by May 1st, 1885, namely, within five months from the time of the order leaving here; and a still more satisfactory part of the business is that *they will be delivered for fully* £400 *per engine less than the English ones.*

Invention is incredulous as to reported superiority of American locomotives, but appends the following pertinent remark:

That our British engineers will have to keep up to the requirements of the times, if they do not wish to be left behind in the race of competition, we have repeatedly pointed out of late, but we refuse to believe that they are so wanting in inventive genius and engineering skill as to be so easily beaten by their American competitors.

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NEW YORK, JANUARY 2, 1886.

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Mechanical Pirates.

In another column, under the above heading, a correspondent presents some pertinent remarks which suggest a somewhat wider application than is there indicated.

The machinery establishment, for example, which, in bringing out a new machine, sedulously strives to keep its internal construction and methods of operation secret, is likely to find that while its competitors have not been kept in ignorance, the busiest, and therefore the most influential, portion of the mechanical public have overlooked its just claims to priority. In many cases it may even be hastily assumed, if there is any thought of piracy in the case, that the real originator is the pirate.

Most of the illustrations of the practice cited by our correspondent, however, touch upon the other side of the question. The publicity given to the true authorship of the thing stolen, not only enables our correspondent, but thousands of other intelligent mechanics to say instantly in their own minds, at least, when a borrowed production is presented to them: "Why, you stole this from So-and-So, didn't you?"

Knowledge of the true ownership of things so stolen thus becomes about the best protection an unpatented design or device can have, which is further attested by the fact that copyist-establishments and copyist-newspapers are not usually entrusted by the public with a large share of either confidence or business.

Another phase of this subject recurs in the experience of establishments who invent some appliance, not for sale, but for use in their own work, and afterward find themselves assailed with demands for damages by some borrower, who took the idea from their practice, discovered that it was unprotected by patents, and forthwith decided to pose as an inventor. A railroad official, who sometimes contributes practical articles on mechanical subjects to the AMERICAN MACHINIST, recently patented a device now in use on his road, mainly to forestall possible claims by "mechanical pirates," for royalties based upon the use by his own road of his own invention.

In the discussion of the paper on pipe and pipe-threads, which appears elsewhere in this issue, the remarks of Mr. Baldwin, to the effect that American pipe fittings could not be sold in the South American market because the first fittings used there were of English make, and American fittings did not correspond, has a wide application. It is a difficult matter to change existing mechanical conditions in such countries, hence the advantage of being first in the market, in order, as far as possible, to give shape to these conditions. Failing in this, it is essential to furnish exactly what the people want. In many instances manufacturers in this country have built up, and held, valuable foreign trade through a careful study of the wants of their customers; held it in spite of repeated efforts to dislodge them by manufacturers in other countries who proposed to sell what they made, rather than what customers desired.

The commissioners for devising plans for putting the telegraph and other wires underground in New York City, say they have had over 100 models of plans submitted to them, and no end of advice in the matter. Perhaps the very multiplicity of plans offered hinders the selection. It is to be presumed the commissioners could spend their time for the next ten years in examining plans that may be urged upon their notice. But the citizens are anxious that they shall adopt one, and get to work on the job. We wish we could see some reason for believing that they will do so.

If not much can be said of the artistic beauty of the pictures that adorn the daily press, the rapidity with which the drawings are executed and the engravings got ready for the press is worthy of praise. Work is sometimes begun on the drawings at dark, and the illustrations appear in the paper the next morning, and this when the subject is quite an extensive one. One thing should be noted in reference to the appearance of these engravings, that is, that the speed of printing is so rapid, and the quality of the paper used such that the finest of cuts would not present anything like a satisfactory appearance.

A Supreme Court Decision That Affects Railroads.

The Supreme Court in Ohio has rendered an important decision, to the effect that it is unlawful for railroad corporations to discriminate in favor of large shippers by giving them a rebate. The grounds upon which the decision was rendered were that such discrimination tended to create monopoly, and injure and destroy the business of small operators, which was contrary to public policy. The decision is a righteous one, and we hope it will have its full effect. At the same time, we fear that ways will be found to evade the law.

Railroad corporations generally find means to compass their desires, notwithstanding law and judicial decisions. Many manufacturers have found to their sorrow that unjust freight rates may ruin a business. It is satisfactory, however, to know that attention is being turned in the right direction, and eventually the failure of present laws to secure justice will lead to the enactment of those so stringent that even railroad corporations will not be able to find a way around them.

Talk of a New Department of the Government.

There is talk of introducing a bill in the House of Representatives creating a new department of Government, to be known as the Department of Labor, the head of which shall be a Cabinet officer. A proposed feature is the requiring of sworn statements from employers covering the wages paid by them, and the profit realized on capital invested. It is possible that such a department might do useful work, but the clause requiring the disclosing of business affairs is too inquisitorial in its nature to be tolerated in this country. Employes as well as employers would object to officious meddling of this kind. This clause will have to be eliminated before there is any prospect of the passage of the bill.

It is suggested by some shrewd business men that Pittsburgh may be building too much on natural gas; that with all her manufactories arranged for using this fuel, the failure of the supply some day will leave the city in the dark in more senses than one. On the other hand, it is believed by many that in the regions of cheap coal, gas will soon be made so cheaply as to come into general use in place of solid fuel, and that it will gradually take the place of natural gas, as the supply of the latter diminishes. It is to be hoped that this latter view of the case is the correct one.

The occurrence of accidents at the aqueduct, to which we have already referred, seems to be increasing with somewhat frightful rapidity. A few such enterprises under way at the same time in the country would be as effective in reducing the population as a good-sized war. And this work is popularly supposed to be overlooked by New York City officials. A comparison of this work with that done by Gen. Newton at Hell Gate, without the loss of a single life, is suggestive of different methods of engineering work.

The paper on "Standard Pipe and Pipe Threads," by George M. Bond, which appears in this issue, has been revised for us by the author; it has not been published before in the revised form.

The Board of Education, of Lockport, N. Y., have decided, and are taking steps, to start an evening school in the common branches, for persons whose time is taken up during the day, and it is proposed to include drafting among the branches taught. The classes will meet for the present in the High School building, two evenings weekly, for the common branches, and one for drafting and book-keeping.

A recent improvement at the New Orleans Exposition is maintaining steam communication with the buildings. The exhibits are not yet in position to a satisfactory extent.

Room for Missionary Work.

We believe there is opportunity for effective missionary work among the miners and mine owners in this country. The record of suffering from strikes and lock-outs is unpleasant reading. It does not appear to the observer that all the differences arising could not be settled by arbitration as satisfactorily to all parties as they are now settled by strikes and lock-outs, and with the absence of suffering, if not actual starvation, that now ensues. If humanitarians would expend some of their energy at home in helping to devise better means of settling labor disputes, much good might result. The coal mines are nearer to us than the South Sea Islands.

It is being remarked that electric-light engines on shipboard do not work regularly, because, in exhausting into the condenser, the "compression upon which the electric-light engines greatly depend for their regulation is taken away." It will be news to engine builders that they cannot furnish engines that will exhaust into the main condenser, or into an independent condensing apparatus, and regulate as closely as may be desired. The Pennsylvania Railroad Company use independent condensing apparatus with the electric-light engines on their ferryboats, and there seems to be no trouble with their lights.

The chief engineer of the Silver King Mining Company, in renewing his subscription, writes us from Arizona: "Don't miss any numbers, or somebody else will be on the "war path" besides the Apaches. We are so far from anybody that the AMERICAN MACHINIST is the only means I have of knowing what's going on. *Sabe, Senor?*"

Literary Notes.

THE COST OF MANUFACTURE AND THE ADministration of Workshops, Public and Private. By Captain Henry Metcalf, Ordnance Department, U. S. A. New York: John Wiley & Sons.

The author of this work has treated his subject in a more comprehensive manner than has probably ever before been attempted. It will suffice in this respect to say that it would be difficult to conceive of anything pertinent that has been omitted. The duties of clerks in connection with the system mapped out, are clearly defined, and *fac-similes* of cards and blanks are given. The author has had extended experience in large Government shops, and has evidently studied the needs of such institutions with great care and minuteness. Realizing, however, that the system he sets forth might be too cumbersome for ordinary private works he has excepted certain parts of his work with special reference to such works. The style is pleasing, and the typographical appearance of the work excellent. We believe that it will be found to contain very valuable hints even to those who will not care to adopt the system as a whole. The price is $5.00.

WORKSHOP RECEIPTS (FOURTH SERIES). BY C. G. Warnford Locke. E. & F. N. Spon, 35 Murray street, New York.

This book is a continuation of the series of books on this subject by Mr. Locke. The general headings of subjects treated in the present volume are: Waterproofing, Packing and Storing, Embalming, Leather Polishes, Cooling, Pumps and Siphons, Desiccating, Distilling, Emulsifying, Evaporating, Filtering, Percolation, Stereotyping, Bookbinding, Straw-plait Matting and Basket Making, Musical Instruments, Clock and Watch Mending, and Photography.

These subjects, in their various ramifications are treated clearly and concisely, and in a manner to furnish a large amount of useful information. It is a book of about 500 pages, and sells for $2.00.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(1) C. H. F., Wiconisco, Pa., asks with reference to patching iron with copper: Does copper expand with heat? *A.*—All metals expand under heat. Copper expands about 50 per cent. more than iron.

(2) H. A. S., Charlotte, Me., asks: How much oil ought a 5′×7″ cylinder at 250 revolutions per minute to use, and what kind of oil? *A.*—Not to exceed one pint per day. Use some of the prepared cylinder oils which you will find in the market.

(3) C. K., Kalamazoo, Mich., asks: Will you give me a receipt for tinning brass castings? *A.*—Make a saturated solution of oxide of tin in potash lye, and add some tin shavings to the solution. Keep the solution hot, and dip the castings, thoroughly cleansed, for a few seconds.

(4) F. S. J., Waukesha, Wis., asks: 1. I have a boiler 18 feet long, 4 feet diameter, with 36-inch tubes 4 inches diameter. At what horse-power would it be rated? *A.*—We should say about 50. 2. What should be the grate surface? *A.*—20 to 22 square feet. 3. How much below the boiler should the grate be? *A.*—We should make it 30 inches. 4. How high should the chimney be? *A.*—From 60 to 100 feet, the higher the better.

(5) J. M., Newark, N. J., asks: 1. What influence does an air chamber on the suction pipe of a pump have? *A.*—It tends to keep the supply more regular, and avoids shock in starting and stopping the suction water column. 2. I have seen a pump with air chamber on the side opposite the suction connection. Does it do any good there? *A.*—Undoubtedly it does. It is, we think, better, however, to place it in suction pipe close to pump.

(6) R. B. G., Rutland, Vt., asks: Is there a solution—except by logarithms—to the following problem, viz.: To raise 127 to its 2 37-100th power? *A.*—Reducing the exponent of 127 to an improper fraction, it reads 237-100; or, by algebraic statement,

$$\sqrt[100]{127^{237}}$$

therefore, to obtain an arithmetical solution, evolve 127 to its 237th power, and extract the 100th root of the quantity thus obtained.

(7) C. E. P., Louisville, Neb., writes: 1. What is the best time to empty a horizontal tubular boiler for cleaning; with steam on, or some time after fire is drawn? *A.*—In our opinion, some time after the fire is drawn. 2. Is black or West Virginia oil of any value as a scale solvent, and does it cause foaming? *A.*—We do not think it very often operates as a solvent of scale; it will sometimes insinuate itself between the scale and the iron, with the effect of causing the scale to fall off. Generally, used moderately, it will not cause foaming. With some kinds of water it might do so. 3. After water has passed the valves of a steam pump, will a pipe ¼″ to ⅜″ larger than is calculated make any difference in the working of the pump? *A.*—Generally speaking, the larger the pipes the easier the pump will work. Whether increasing the size of discharge pipe will make any material difference in the working of the pump, will depend upon the present size of pipe, its length, whether it is straight or has bends in it, the speed at which the pump is run, etc.

(8) K. G. McL., Fort Bridger, Wy. T., asks: 1. How to make lead joints in 5″ or 6″ cast-iron water-pipe. *A.*—Place the pipes in position upon blocks, so that the small end of each pipe is in the center of the large end of the next piece of pipe. Roll up a loose rope of tow, lap it around the small pipe and press snugly into the end of the large pipe. The object of the tow is to prevent the lead from running into the interior of the pipe. A roll of putty, or tempered clay, is pressed firmly around the opening between the small and large pipes, to keep the lead from running to waste. An opening is left in the clay at top of the pipe and melted lead is poured in, until the cavity between the tow and the putty is completely filled. Next, the putty is removed and the lead is caulked until the joint is water-tight. Square-end steel tools are used for caulking, shaped like those used to drive splines out of pulleys and gears. The value of the joint depends upon the manner in which the lead is made to fill the space between the two pipes. When the lead cools, after being poured, it shrinks and leaves a space between the lead and the outer pipe. By "tamping" or caulking the lead, it is upset until every portion of the space between the pipes is completely filled. 2. What are the tools required in constructing water-works on a farm, so as to bring water into all the buildings? *A.*—A plumber's outfit is the best, but the job can also be done by boring wooden logs with an auger, and using the bored logs for pipes. The better way is to use lead pipe, unless the chemicals contained in the water are such as to corrode lead, in which case tar or zinc-lined iron pipe should be used, and a steam-fitter's tools are necessary.

(9) A. C., Detroit, Mich., asks: 1. In firing a rifle or cannon why does not the breech receive the same impulse or blow as the ball? *A.*—It does. 2. In an engine fitted with V-slides, the fly-wheel running towards the cylinder, what would be likely to cause wear on the top gib to be more on one side of the V than on the other? *A.*—Improper lining up, or deviation from truth in fitting up some of the parts. 3. In changing from burning soft coal to burning hard, what changes will it be necessary to make? *A.*—Very likely not any. If your furnace burned soft coal satisfactorily it will probably burn hard coal well if the height of chimney is sufficient to give good draft. 4. What is the cause of inside pitting and corroding in a boiler? *A.*—It is often very difficult to determine. Very likely it is something in the water you use. 5. What is it that causes the snapping in steam heaters in cold weather? *A.*—It comes from condensation of steam.

(10) C. H. H., ——, writes: I have charge of the repairs in a large job printing establishment, and have to make the ink rollers. They do not give satisfaction. Can you give me a good recipe for mixing and casting the same? *A.*—It does not pay printers to cast and recast their ink rollers, unless they are in very remote localities. Even then, it is better to buy the composition prepared ready for use, and needing no further manipulation than simply melting and pouring into the moulds, which should be greased previous to pouring. "Improved roller composition" may be ordered of any dealer in printers' material. The principal ingredients of such composition are; glue, 1 lb.; molasses 1 pt; glycerine, 1 oz., with slight additions of other unimportant ingredients, according to different makers' formula. Air bubbles in the rolls is the greatest fault in home-made rolls. These may be avoided by pouring the composition into the mould very slowly. The stream from the ladle should not be more than ¼″ in diameter. By the above means, air-bubbles have a chance to rise to the surface, and are also prevented, to a great degree, from becoming entangled in the melted composition, which is the chief cause of this trouble.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

T. M. Parker, Steel Stamps, Stencils, Hart'f'd, Ct.

J. Clayton, Air Compressors, Rock Drills. 43 Dey st, N.Y.

Edw. Sears, wood engraver, 48 Beekman st., N.Y.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

Tack, Wire, and Shoe Nail Machinery; Wm. A. Sweetser, Brockton, Mass.

Steel shank, wire nail, shoe nail and tack machinery. Keith & Trufant, Campello, Mass.

Tack and Wire Nail Machinery, made by the Willets Mfg. Co., Providence, R. I.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Patent attorney and expert. Machine designs and details. Wm. H. Weightman, 82 Astor House, N.Y.

Foot-Power Machinery for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Lyman's Gear Chart. How to lay out gear teeth. Price, 50c. E. Lyman, C. E., New Haven, Conn.

Machines to form and bend steel and iron; run by power. Williams, White & Co., Moline, Ill.

Improved Labor-Saving Upright Drills. 20 in. to 36 in. inclusive. Currier & Snyder, Worcester, Mass.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

E. Merritt & Co., Brockton, Mass., established 1859, only manufacturers of a complete line of Tack and Nail Machinery. Send for circulars.

Files recut without drawing temper, about one-half usual prices; samples recut free; prices on application. The Acme Co., Collinsville, Conn.

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-Taught;" $4. Books for workmen. Joshua Rose, Box 3306, New York City.

Kellam's Pressure Regulator—used in heating system of 11-story building, Madison ave., N. Y.,—saved, last season, $2,000 over previous season. Hine & Robertson, 12 Cortlandt street, New York.

Locomotive Engine Running and Management. By Angus Sinclair. Gives full directions about handling and repairing locomotives; instructs how to design valve gear and set valves; Westinghouse air brake explained by aid of engravings. Price, $2. For sale by *National Car Builder*, 187 Dearborn st., Chicago, Ill.

Every young man who aspires to be either a mechanic, merchant, or manufacturer, owes it to himself that he become thoroughly familiar with the writings of Chordal. John Wiley & Sons, 15 Astor Place, N. Y., have issued a new and enlarged 12 mo edition of "Extracts from Chordal's Letters." Handsomely bound in cloth, with over 50 illustrations. Price, $2. Discount of 25 per cent on orders for five or more copies.

MANUFACTURES.

Racine, Wis., wants bids for water-works construction.

J. P. Witherow is making preparations to erect boiler works at New Castle, Pa.

C. J. Cobleigh, piano case manufacturer, Leominster, Mass., is enlarging his factory.

The Struthers furnace, Youngstown, Ohio, has been fired up after being idle two years.

The Cambria Iron Company, Cambria, Pa., has bought the Mahoning Coke Works at Dunbar for $35,000.

The Forest Paper Company, Yarmouth, Me., are making extensive improvements in and about their mills.

The Pinkerton Works, Green Island, Mich., are building a large cupola for the Fuller & Warren Company.

Joseph Smith, 466 W. 23d st., will erect a 3-story ladder factory at 50th street and Twelfth avenue, New York. G. B. Pitham, architect.

Beadleston & Woerz will erect a four-story engine and boiler-house at 10th near Washington st. A. Pfund & Son, architects.

The Michigan Iron Works Light and Power Company property, Grand Rapids, Mich., is to be sold December 30, by W. R. Shelby, assignee.

The New York *World* is about to put in a six horse-power engine, made by Jones & Hitchings, Portland, Me., who report business as good.

The Shamokin Hosiery and Woolen Goods Manufacturing Company, Shamokin, Pa., will soon be started up by Owen Morgan & Co., of that place.

Rowell & Johnson, Clinton, Me., have contracted to make pill-boxes for a New York firm, and are now enlarging their wood-turning establishment.

The Windsor Foundry Company, Windsor, N. S., have perfected arrangements with the American Ship Windlass Company, of Providence, R. I., to manufacture their windlasses and capstans for the Dominion of Canada.—*Industrial Journal.*

The Bowdoin Paper Manufacturing Company, of Lisbon Falls, Me., will erect a large mill early the coming year. The capital invested reaches nearly $1,000,000, and the town will exempt the company from taxation for 10 years.—*Boston Commercial Bulletin.*

The Norway Water Supply Company, Norway, Me., have closed a contract with Henry R. Worthington, of Boston, and it is expected the new works will all be complete by next fall. The water is to be forced into a reservoir on Pike's Hill.—*Industrial Journal.*

Foster & Sons, St. John, N. B., are doing a large business in the manufacture of cut nails, tacks, brads and shoe nails. They cut up a thousand tons of iron, steel and other metals yearly into their specialties, and employ a large number of hands.—*Industrial Journal.*

A tract of land adjoining the North Pennsylvania Railroad at Quakertown, Pa., has been purchased by Messrs. Haigh & Brother, of England, for the erection of a large woolen mill. Building operations will begin next spring. It is estimated that over 100 hands will be given employment.

The Bath *Independent* says that Boston gentlemen of capital are seriously considering the project of constructing a marine railway at the shipyard of Hon. Wm. Rogers, Bath, Me., capable of holding the largest ships. A representative from Boston was in Bath recently to look at the proposed location.

The Hall Steam Pump Company, 91 Liberty st., New York, has issued an illustrated catalogue of their duplex steam pumps and pumping machinery. In addition to a full description of their pumps, which are made for all purposes, the catalogue contains useful information for engineers and others.

It is expected that the new steel cruisers Boston and Atlanta will be ready to receive their officers and crews about the first of March next, and that the cruiser Chicago launched at Chester, Pa., about the third of December, will hardly be ready for sea service before the end of next year.—*Maritime Journal.*

The Calumet Iron and Steel Company at Cummings, Ill., in the suburbs of Chicago, announce that the nail plate mill and factory will start up at once, and men in need of work should apply to the superintendent. The works have been idle since June 1, the men insisting on a 21-cent rate and the company refusing to pay but 17.

James Brandon, 233 Tenth avenue, New York, has issued a 17-page catalogue of his piston-packing ring, which was illustrated not long since in the AMERICAN MACHINIST. Outside of the reference to the particular ring of his invention, there is much that will be interesting in relation to the pressure on packing-rings, including a reprint of a very interesting paper, by Professor Robinson, on the equilibrium line on valves. The catalogue is illustrated.

According to the *Sanitary Engineer*, a syndicate of capitalists have bought the Hayes foundry at Buffalo, N. Y., and will go into the manufacture of cast-iron water-pipe on a large scale. Surveys are being made for water-works at Little Falls, N. Y.; and Beverly, Mass., will build a reservoir and pumping station in the spring.

City Engineer Sproatt has submitted to the City Council of Toronto, Ont., a report on widening and straightening the River Don, including repair or reconstruction of bridges. His estimate of cost, exclusive of land, is $196,350. Some of the items are: 354,000 cubic yards of excavation, at $53,100; piling, etc., $28,800; raising flats, $61,000; two bridges, $42,000.—*Sanitary Engineer.*

According to a press dispatch, a co-operative nail company, with a capital stock of $100,000, all of which has been subscribed, has been organized by a number of striking nailers and hardware dealers in Pittsburg, Pa. The charter for the company was procured last week. Five acres of ground have been given to them at Homestead, and it is their intention to erect a factory at once.

The Volker & Felthousen Mfg. Co., Buffalo, N.Y., write us: "We note in your last issue that 'this company has been organized to succeed E. G. Felthousen in his specialties.' This is an error. This company was organized for the purpose of manufacturing duplex steam pumps. Mr. E. G. Felthousen is a stockholder, but still continues his specialty business on his own account.

The Indurated Fiber Company, of Lockport, N.Y. recently incorporated with a capital of $30,000, have commenced the erection of a plant at Lockport, for the manufacture of pails, dishes, etc., from wood pulp, under license granted by the parent company at Portland, Me. Jesse Peterson is president, and H. G. Cordley secretary and treasurer. They expect to be ready for business by March, 1886.—*Bradstreet's.*

The Cowles Electric Smelting and Aluminum Company, of Cleveland, Ohio, has broken ground for the erection of buildings, 200 x 100 feet, at Lockport, N. Y., for the manufacture of aluminum and bronze. It is stated to be their intention to use twelve dynamos, of 125 horse-power each. They will probably employ about seventy-five hands, and expect to commence operations in the early spring.—*Bradstreet's.*

G. A. Gray, Jr. & Co., Cincinnati, O., write us that since they have issued their new reduced price-list of 17-inch and 20-inch lathes, and 24-inch and 30-inch planers, they have had a large increase of orders, and have found it necessary to increase their plant and run at night. They have put in for their own use one Gray planer, one Hendey shaper, one Lodge shaper, two Gray 17-inch lathes, one Universal Radial Drill Company's radial drill, and one Gould & Eberhardt automatic gear-cutter.

A recent Pittsburgh dispatch says: "Ten per cent. additional of the syndicate coke ovens in the Connellsville region have been fired up, making 90 per cent. of the total number now in blast, against 50 per cent. a few months ago. The coke trade is now better than it has been for years. Both the syndicate and independent operators report a largely increased output during the past month. There is not an idle workman in the region, and all the indications point to prosperity. The improvement is a direct result of the activity in the iron and steel industries."

Uniontown, Pa., having secured the Columbia Iron and Steel Works and the works of the Pennsylvania Construction Company, by donating the land and taking $60,000 of the $400,000 capital stock, work is to go forward in establishing the industries. E. M. Butz, one of the stockholders, came up with four engineers from Pittsburgh, and the ground is being staked out for the erection of the construction shops. The machinery of this company is now within the Penitentiary walls, but, under the new law regarding convict labor, they must seek new quarters by January 1.—*Boston Commercial Bulletin.*

Brooklyn, N. Y., proposes to extend her water works. The engineer in charge thus speaks of the proposed pumping engines at Millburn station: "Considering that the suction will be about fifteen (15.0) feet as a maximum, and generally not more than thirteen (13.0), and that the total lift or difference between water surfaces will not exceed forty-five (45.0) feet, it is proposed to adopt horizontal compound engines, so connected that each engine may be worked quite independently of the others. There will be three horizontal engines alike in their dimensions, arrangements and details in every respect; and each engine is to work two double-acting plunger pumps having a delivery capacity for regular daily work of ten million U. S. gallons per twenty-four (24) hours, when the engine is making thirty-four revolutions per minute. The general description and specifications of these engines have been completed by Mr. Chas. W. Copeland. Estimating the additional supply to be obtained at 20,000,000 there would be always one engine for reserve, besides the large margin allowed for the increase in speed beyond the low limit prescribed. The engine and boiler-house will have ample capacity for six engines of the above description, of which only three will now be erected and a small independent one of four-million capacity for the Millburn pond, and the remaining space will be used for machine shops, carpenter and blacksmith shops etc."

The Brown & Sharpe Mfg. Co., Providence, R. I., have recently made a reduction in the prices of their Universal Milling Machines.

Machinists' Supplies and Iron.

NEW YORK, Dec. 16, 1885.

A stronger feeling has been developed in the market, but there has been less activity than there was during the past week.

Iron—In American pig, production seems to be increasing. Prices for future delivery have not been settled, but it is probable that they will be advanced. Forge irons are scarce. Standard Lehigh and North River, $18 to $18.50 for 1 X Foundry at tidewater; $16 to $17 for No. 2; and $14.50 to $15.50 for Grey Forge at furnace.

Scotch Pig—No quotable change, and supplies firmly held. We quote Coltness, $19.50 to $20; Glengarnock, $18.50 to $19 to arrive; Gartsherrie, $19 to $19.50; Summerlee, $19 to $19.50; Eglinton, $17.50 to $18; Langloan, $19.50, and Dalmellington, $18.25.

Lead—The market is a shade firmer, at $4.80 for spot, $4.60 for January deliveries

Copper—Moderate demand; supplies firmly held. Lake, 11¼c.; other brands at 10¾c. to 10⅝c.

Tin—Market firmer. Jobbing lots, Banca, 21½c.; Straits and Malacca, 21c cash

Spelter—Light and dull. Refined, 5¾c. to 6c.

Antimony—Hallett's, 8½c.; Cookson's, 9.45c. to 9.50c.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Foremanship of foundry; experienced in mining, milling, engine and railroad work; references. Address, Energy, AM. MACHINIST.

Wanted—Foreman for boiler and plate-iron works; one that is correct in his work and ability to govern men; reference required. Address, J., AM. MACHINIST.

Wanted—Position as superintendent, by practical mechanic and designer; experienced in managing men, and familiar with hoisting machinery, steam-engines and tool building generally. J. C. E., AM. MACHINIST office.

Wanted—A mechanical draftsman who has had experience on machine tools and punching presses. Address, stating age, experience and salary expected, Ferracute Machine Co., Bridgeton, N. J.

Wanted—By young man of good, sober character, a situation as fireman; will work first four months for just enough to pay board. Address, Geo. Baker, Box 75, Weldon, Ill.

Wanted—By practical mechanic, designer and draftsman, position as supt. or foreman of machine works; have had large experience handling men and systematizing work; best reference given; corresp'ce solicited. Address Box 486, Waterbury, Ct.

First-class superintendent wanted to take full charge of a manufactory of light machinery and small hardware; must be good designer and draftsman, know how to handle men and make work cheap; state salary expected, age, experience, with reference. Address, Business, AM. MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 25 cents per line, each insertion.

The Cyclone Steam Flue Cleaner has no equal. Crescent Mfg. Co., Cleveland, Ohio.

Comb-Grailing Machine wanted by Zylonite Comb and Brush Co., Adams, Mass.

Light mach'y of all kinds built at short notice. Pennington & Mills, 8 Dey st., Jersey City Heights, N. J.

Machine shop with small expense wants patented article to build. H S Phillips & Co., Burlington, N J.

Wanted—A 4 H.P. second-hand gas engine. Address, stating full particulars, H. G. T, AM. MACHINIST office.

For sale, at half price, three dunning boilers; been used one winter. Address, Windsor Hotel, Trenton, N. J.

To make room for larger tool, will sell cheap, for cash, a planer 42"x42"x12', in good order. Address, P. O. Box 2085, Bridgeport, Conn.

Special mch's. for any kind of mfg. designed to order. Also plain and autom'c eng's. Send for circular and refs. Weston & Smith, Syracuse, N. Y.

For Sale—Exclusive right of patented metallic barrow; granted Oct. 21, 1884. Apply to A. M. De Gray, 396 Tonnelly avenue, Jersey City Heights, N. J. No agents.

Wanted—To lease for a term of years, a machine shop and foundry in one of the best towns in Northern Indiana; machinery, patterns and building in good repair; well located for business. Address, A. J. Ross, Wabash, Ind.

For Sale—The steam-engine and machine works of the late William Munzer, including drawings, patterns and tools for building Corliss and Baxter engines, brewer's machinery and machinery generally; also, long lease of premises 204–210 East 43d street, New York. Inquire of L. V. Conover, administrator, 336 East 29th street, N. Y.

Rubber Goods Especially to Order.

Fine and accurate work for Mechanical purposes. Sewing Machine and Electric Light articles. Bicycle Tires, Bottle Stoppers, Seamless Tubing, Pine Moulded Boiler Gaskets and Steam Pipe Rings that never melt or blow out. Extra quality Sheet Packings, Pump Valves, Pure Anti-Thill Rattlers, etc. Estimates for cost of new articles, including moulds when desired.

THE HARTFORD RUBBER WORKS,
HARTFORD, CONN.

CHANDLER & FARQUHAR,

GEARS

177 & 179 Washington Street,
BOSTON, MASS.
Of all kinds in Stock and Made to Order.

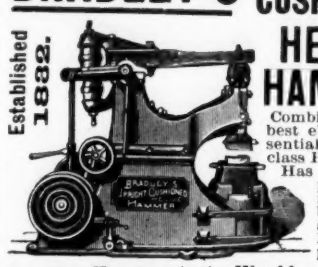
Estimates Furnished for Model or Light Machine Work.

Tools and Supplies for Machinists and Manufacturers.

Send for Catalogue B.

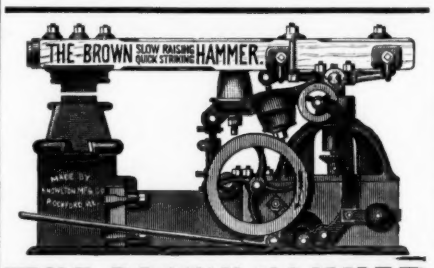
BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

BRADLEY & CO. Syracuse, N.Y.



THE BROWN HAMMER
STRIKES A BLOW WITH
DOUBLE THE VELOCITY That it Raises the Hammer.
A NEW MOVEMENT! SEND FOR DESCRIPTION.
KNOWLTON MFG. CO., King St., Rockford, Ill

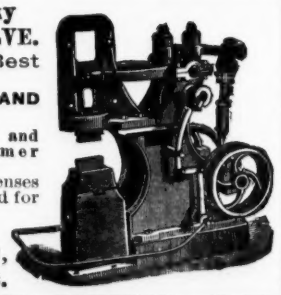
STEPHENS PATENT PLANER CHUCKS

Combine valuable features offered by no other tool. In range of opening; advantage of self-adjusting jaw worked by a single screw; graduated base, etc. Parts interchangeable. Chucks guaranteed. Sold by the trade. Send for Catalogue.

Self-Adjusting. MELVIN STEPHENS, Prop'r, Office, 41 Dey Street, New York.

BEAUDRY'S
UPRIGHT HAMMER

Has no Shaky WOODEN HELVE.
Springs of Best Rubber.
BLOW, TRUE AND ELASTIC.
Most practical and economical hammer made.
Will reduce expenses of any shop. Send for description.



BEAUDRY & CUNNINGHAM,
BOSTON, MASS.

PATENT SOLICITORS

ELLSWORTH & YANTIS,
816 F St., Washington, D.C.
Send for Circular.

SEBASTIAN, MAY & COMPANY'S
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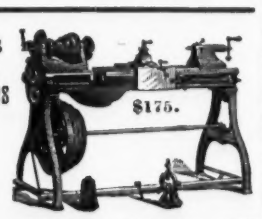

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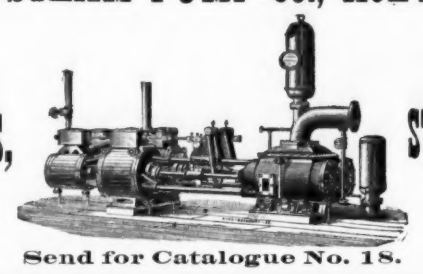

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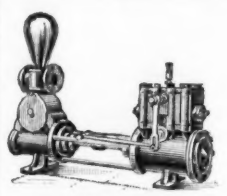

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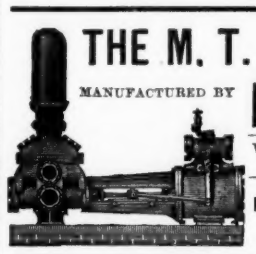

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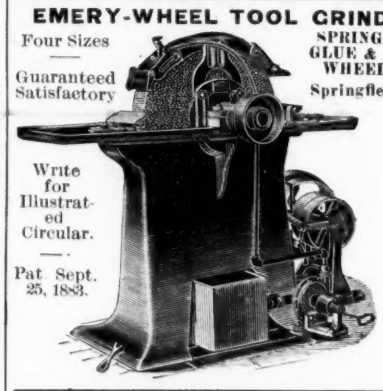

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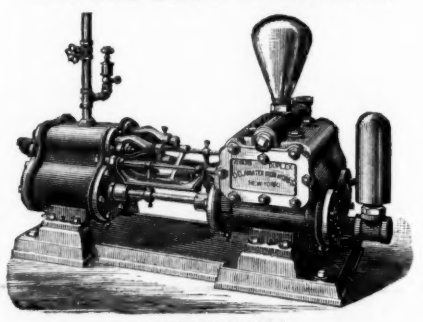

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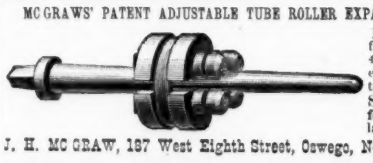

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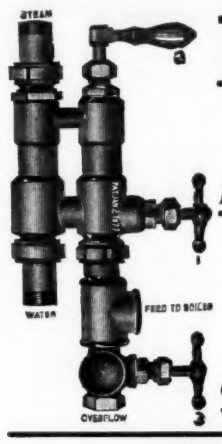

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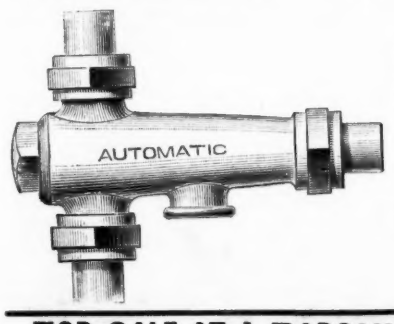

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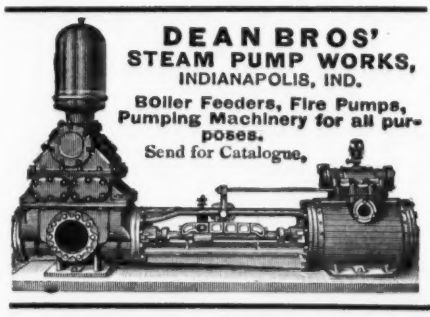

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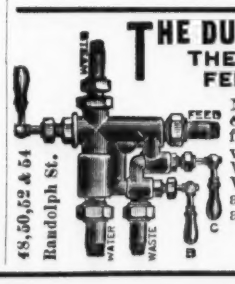

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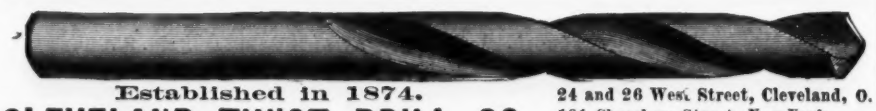

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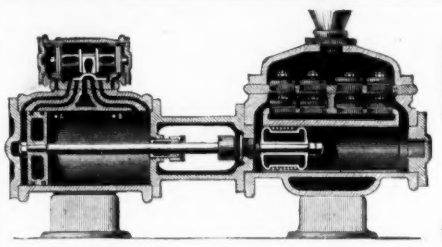

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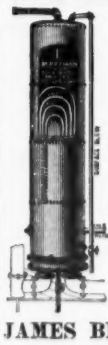

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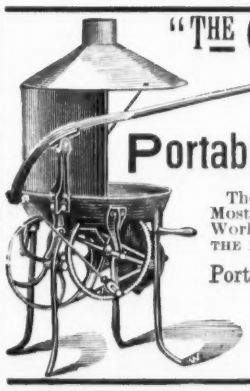

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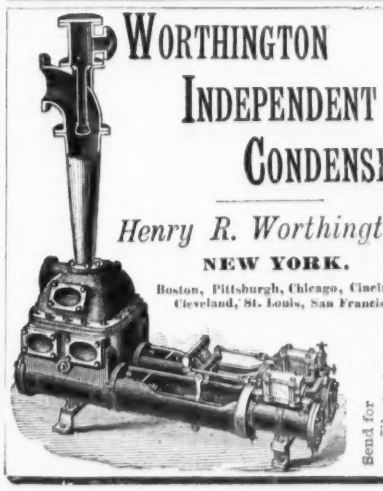

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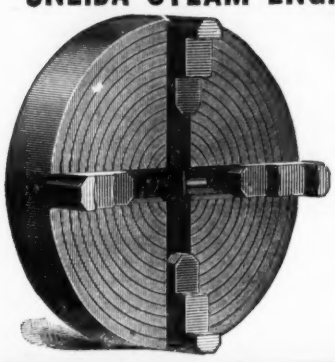

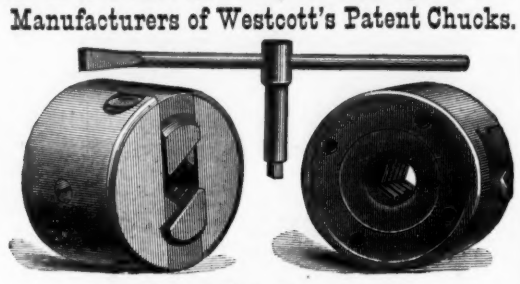

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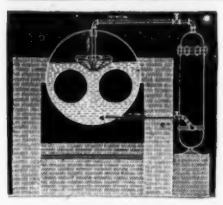

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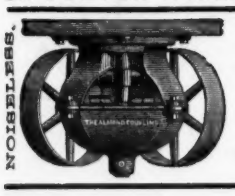

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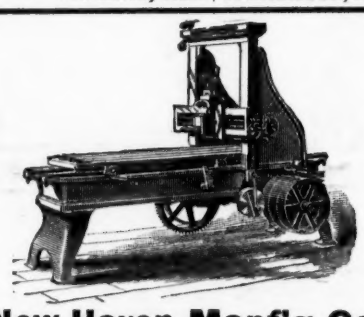

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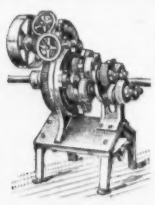

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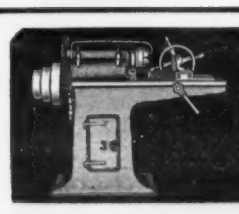

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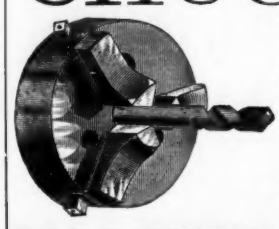

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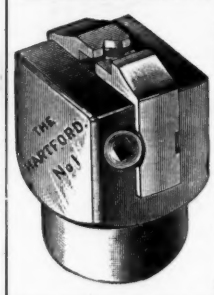

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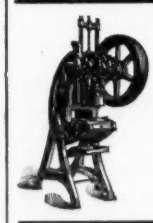

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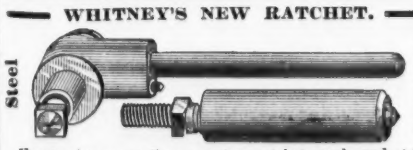

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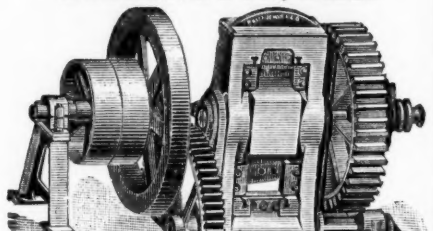

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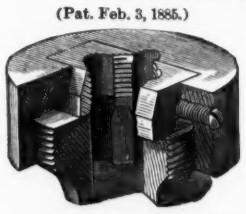

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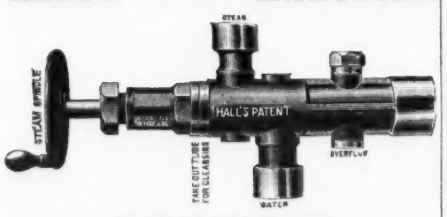

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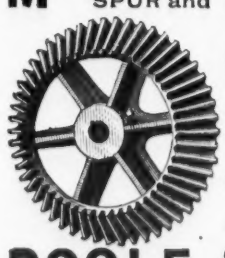

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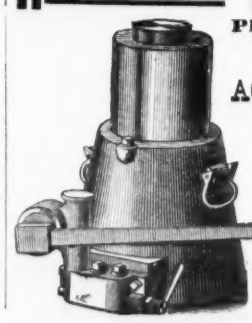

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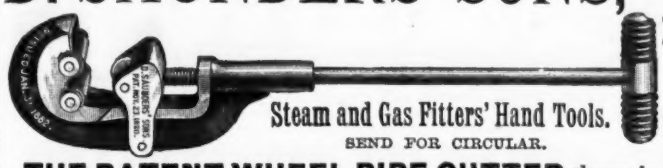

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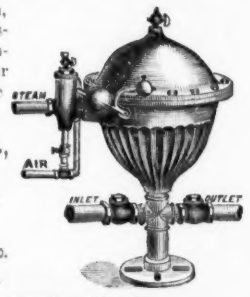

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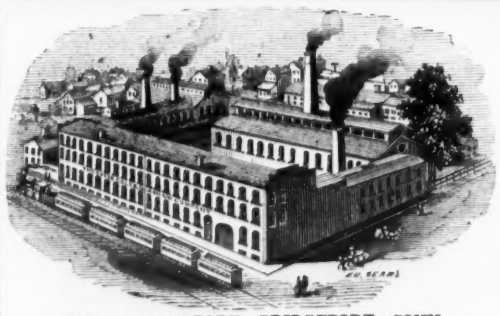

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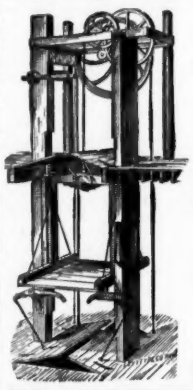

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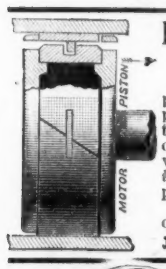

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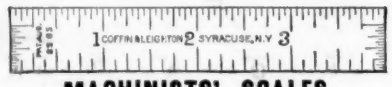

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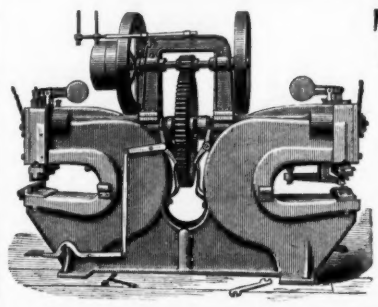

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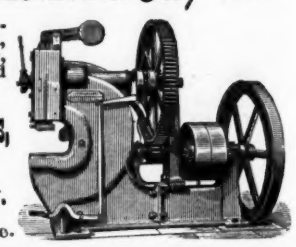

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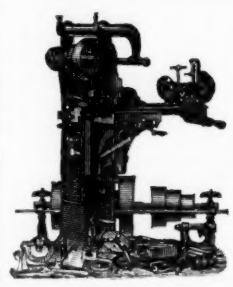

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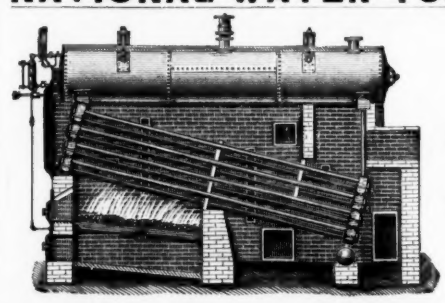

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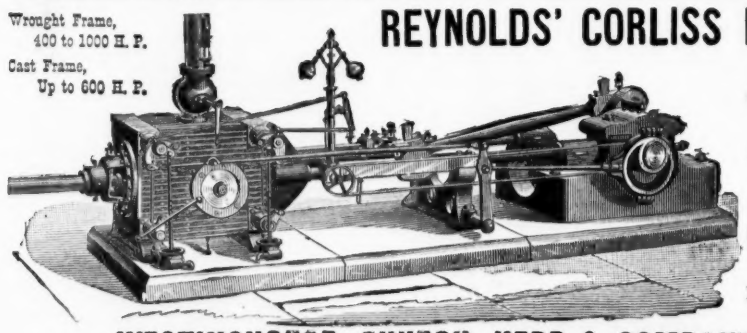

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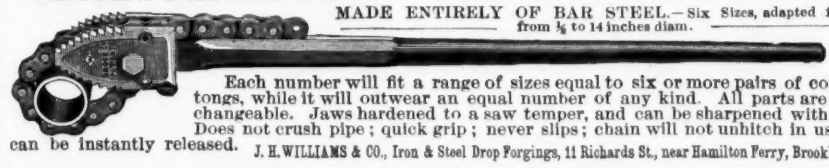

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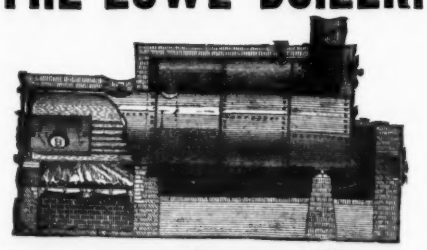

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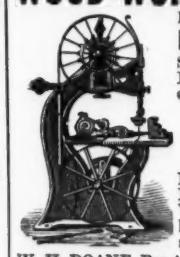

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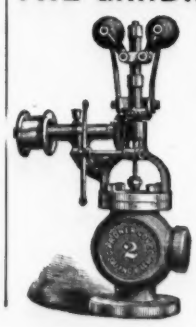

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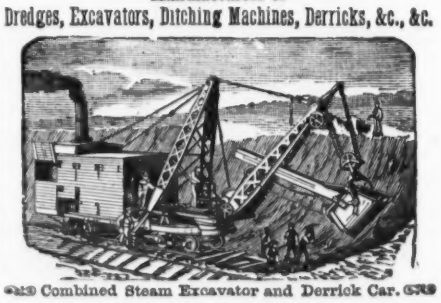

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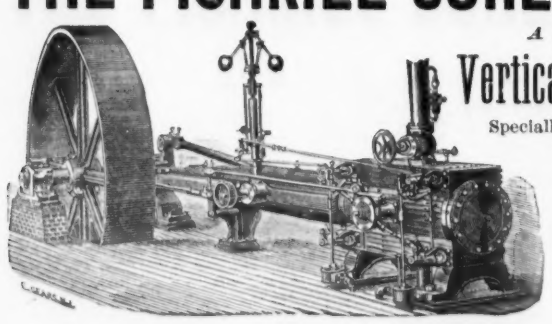

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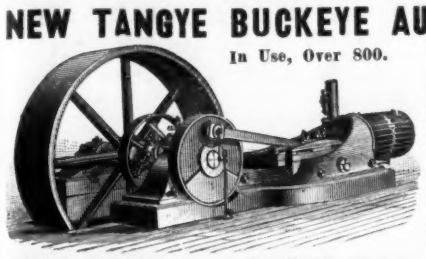

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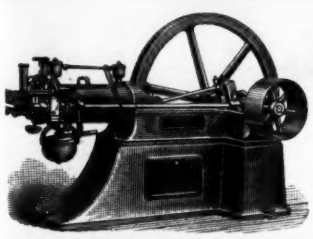

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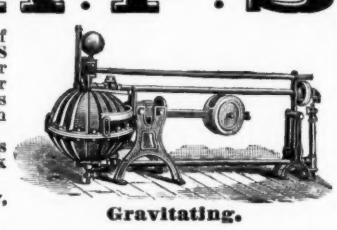

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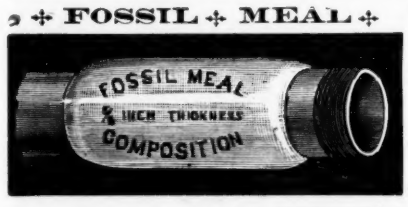

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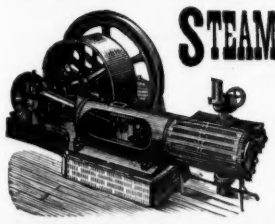

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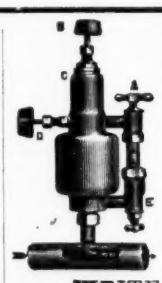

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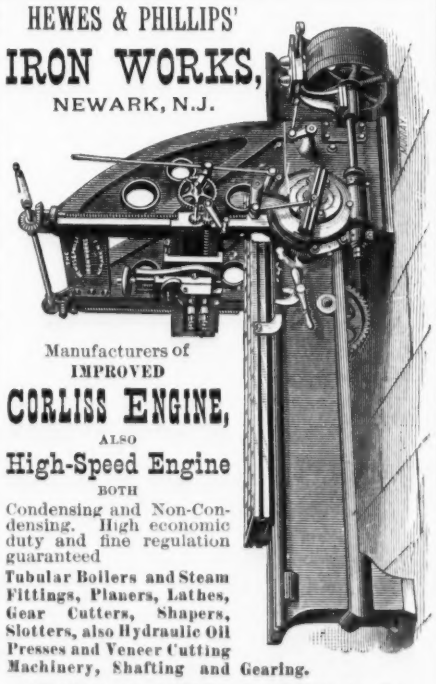

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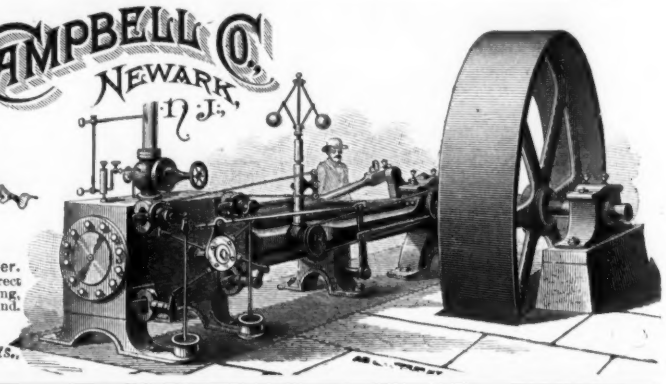

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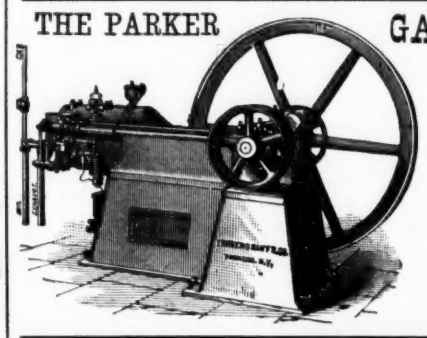

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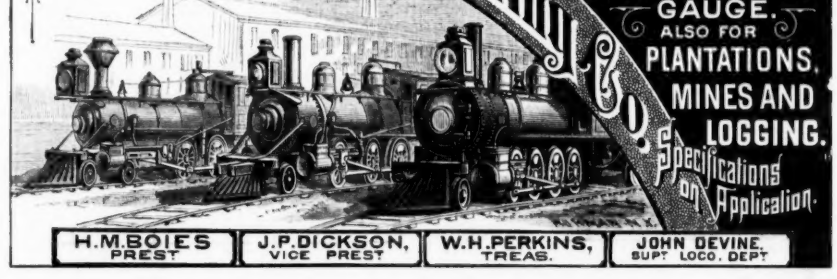

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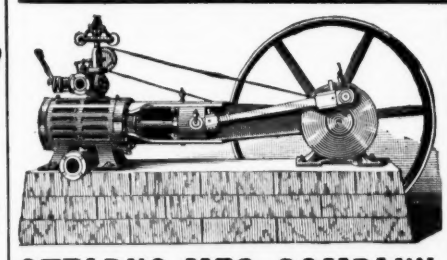

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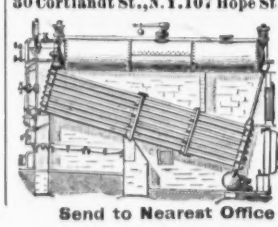

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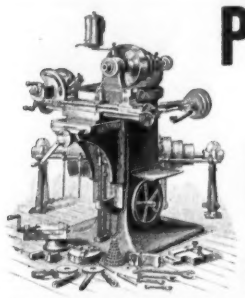

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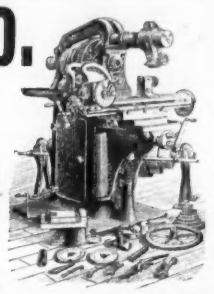

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Are kept in stock and sold at favorable prices, compared with any of their **IMITATIONS.** *By making these Machines in large numbers, with expensive special tools, much greater accuracy has been attained than can be reached by the usual methods of manufacture. The importance of the greatest attainable accuracy in* **TOOL-MAKING MACHINES** *will be appreciated by Machinists.*

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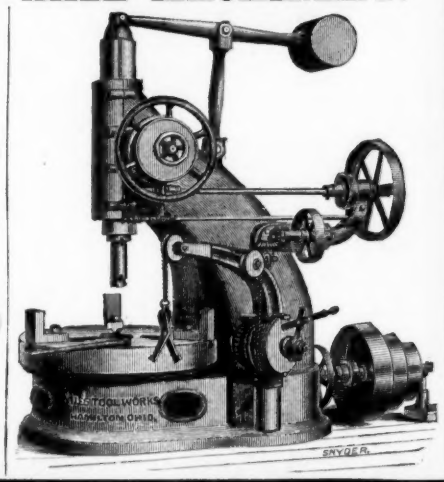

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OF ANY CAPACITY. FOR HAND OR POWER.

Particulars on application, and full specification and tender promptly submitted on receipt of capacity, height of mast, length of radius, and whether to be operated by hand or power.

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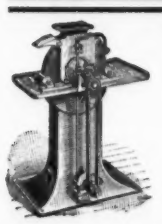

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FOR GRINDING LATHE, PLANER AND OTHER TOOLS.

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FIRST-CLASS PLANERS.

RETURNS OVER 100 FEET PER MINUTE.

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Gentlemen:—In regard to the 26 in. x 26 in. x 8 ft. planer bought of you some time ago, it gives us pleasure to say that it is the best planer we ever saw. The man we have on it says it "Takes the cake," being the best he has run during the thirty years he has been running planers. We are well pleased with our purchase, and no other planer would fill our orders, and we will have no other.

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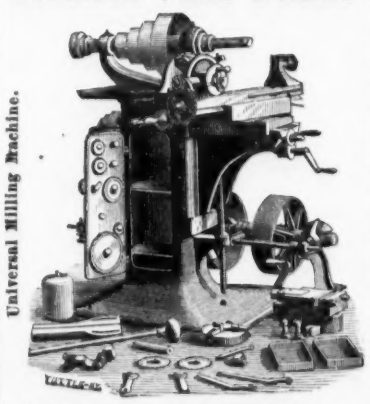

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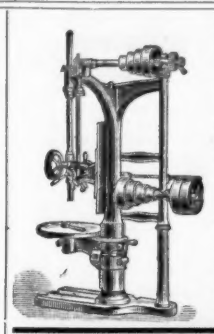

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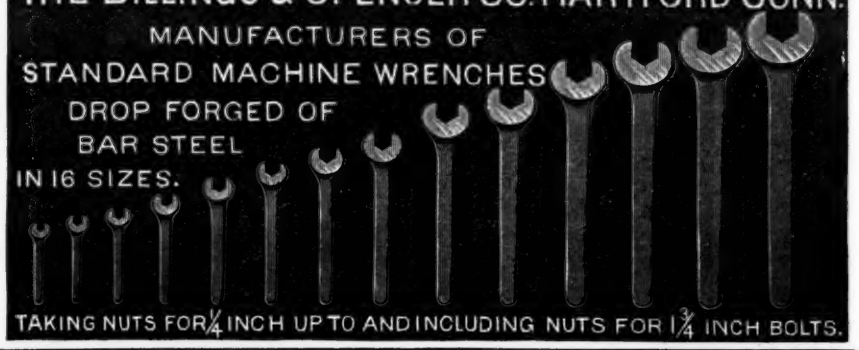

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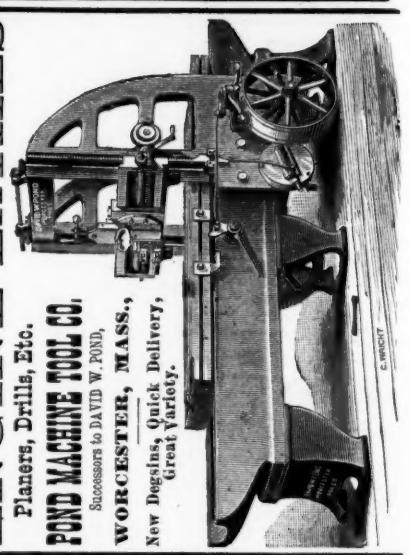

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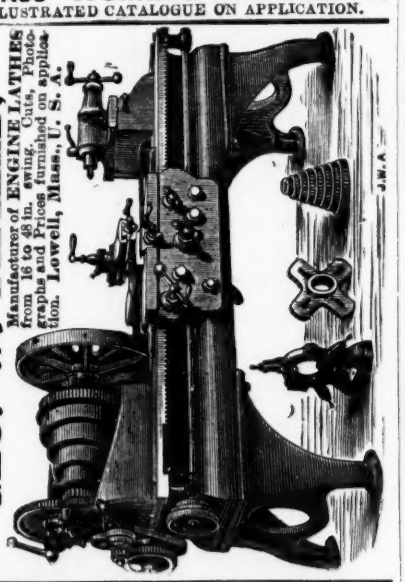

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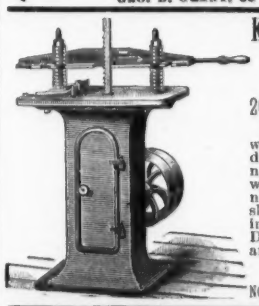

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Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key-Seating Machines and 20-inch Drills. Send for Photo. and Catalogue.

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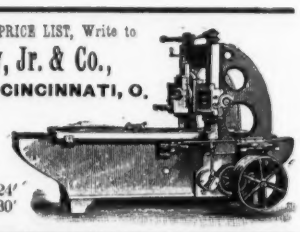

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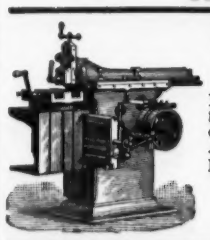

THIS SHAPER HAS 26-INCH STROKE.

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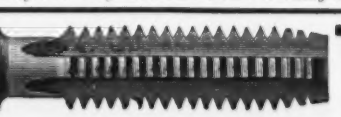

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